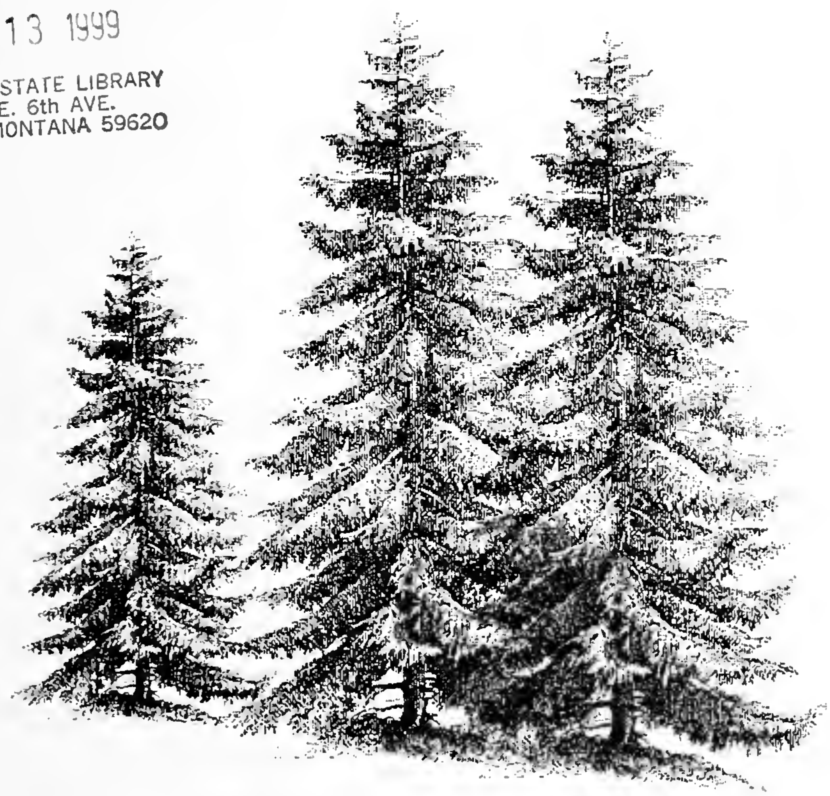
DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR THE PROPOSED LONG COTTON TIMBER SALE

JULY 13, 1999



Prepared by: Montana DNRC
Central Land Office
8001 North Montana Avenue
Helena, Montana 59602

TABLE OF CONTENTS

CHAPTER I - PURPOSE AND NEED

I.PROPOSED ACTIONS AND OBJECTIVES 5
II.SCOPE OF THE PROPOSED ACTION 6
III.CONNECTED AND CUMULATIVE ACTIONS 6
IV.OTHER ENVIRONMENTAL ASSESSMENTS WITHIN THE PROJECT AREA 8
V.OTHER AGENCIES WITH JURISDICTION AND PERMITS REQUIRED 8
VII.DECISIONS TO BE MADE 9
VIII.RESOURCE ISSUES AND CONCERNS 9

CHAPTER II. -ALTERNATIVES

I.INTRODUCTION 11
II.DEVELOPMENT OF ALTERNATIVES 11
III.DESCRIPTION OF ALTERNATIVES 12
IV.ALTERNATIVES CONSIDERED BUT NOT GIVEN DETAILED STUDY 17

CHAPTER III. - AFFECTED ENVIRONMENT

I.GENERAL DESCRIPTION 26
II.VEGETATION 27
III.WATERSHED 36
IV.SOILS AND GEOLOGY 48
V.WILDLIFE 49
VI.RECREATION 71
VII.GRAZING RESOURCES 71
VIII.TRANSPORTATION 72
IX.CULTURAL RESOURCES 73
X.ECONOMICS 73

CHAPTER IV. -ENVIRONMENTAL CONSEQUENCES

I. GENERAL 74
II.VEGETATION 74
III.WATERSHED 82
IV.SOILS AND GEOLOGY 94
V.WILDLIFE 97
VI.RECREATION 112
VII.GRAZING RESOURCES 112
VIII.TRANSPORTATION 113
IX.CULTURAL RESOURCES 115

X.ECONOMICS 115
XI.IRREVERSIBLE AND IRRETRIEVABLE
COMMITMENTS OF RESOURCES 120
XII.RELATIONSHIP BETWEEN SHORT-TERM USE
OF MAN'S ENVIRONMENT AND LONG-TERM
PRODUCTIVITY 120

LIST OF REFERENCES 121

LIST OF PREPARERS 129

CHAPTER I

PURPOSE, OBJECTIVES AND SCOPE

I. PROPOSED ACTIONS

A. DESCRIPTION

The Montana Department of Natural Resources and Conservation (DNRC), Dillon Unit, proposes to harvest timber, and to regenerate trees in the Long Creek, Riley Canyon, Green Canyon and Cottonwood Creek drainage in Beaverhead County. The project area contains approximately 11,671 acres of School Trust Lands of which approximately 1,194 acres are forested.

The proposed activity is to harvest as much as an estimated 3 million board feet (MMBF) of mostly decadent and suppressed Douglas fir, spruce, and lodgepole pine saw timber from approximately 376 acres. Up to 5.5 miles of new road may be constructed and up to 5.3 miles of road reconditioned or reconstructed depending on which alternative is chosen.

B. OBJECTIVES

The lands involved in this proposed project are held by the State of Montana in trust for the support of specific beneficiary institutions such as public schools, state colleges and universities, and other specific state institutions such as the School for the Deaf and Blind (Enabling Act of February 22, 1889; 1972 Montana Constitution, Article X, Section 11). The Board of Land Commissioners and the Department of Natural Resources and Conservation are required by law to administer these trust lands to produce the largest measure of reasonable and legitimate return over the long run for these benefit institutions (section 77-1-202, MCA). On May 30, 1996, the Department released the Record of Decision on the State Forest Land Management Plan (the Plan). The Plan outlines the management philosophy of DNRC in the management of state forested trust lands, as well as sets out specific Resource Management Standards for ten resource categories.

The Department will manage the lands involved in this project according to the philosophy and standards in the Plan, which states:

> "Our premise is that the best way to produce long-term income for the trust is to manage intensively for healthy and biologically diverse forests. Our understanding is that a diverse forest is a stable forest that will produce the most reliable and highest long-term revenue stream...In the foreseeable future, timber management will continue to be our primary source of revenue and our primary tool for achieving biodiversity objectives."

The objective for this proposal is to generate revenue for the trust through the harvest of timber from the project area and to promote a diversity of stand structures and patterns for a long term sustainable forest. A conservation license, that would compensate the

Trust without harvesting timber, was discussed with the Montana Department of Fish, Wildlife and Parks but that Department decided they were not interested in pursuing such an agreement. No other revenue generating proposals were discovered during the development of this proposal nor are any known by the DNRC at this time. The proposal would not exclude present uses.

II. SCOPE OF THE PROPOSED ACTION

The scope of the proposed actions addressed in the EIS is limited to the specific timber harvest, and associated activities. The EIS is not intended as a programmatic or area plan.

A. GEOGRAPHICAL AND SPATIAL BOUNDARY

The Long/Cotton Timber Sale is in Southwest Montana, approximately 18 air miles southeast of Dillon, Montana. The project area lies in the Blacktail Mountains from approximately 7,000 to 9,000 feet elevation. The boundary of the project area follows the boundary of the State ownership. The northern boundary lies approximately ¾ mile north of Blacktail Ridge in Riley and Green Canyons and along Blacktail Ridge, the southern boundary is along the Township boundary, the east boundary is the ridge between Cottonwood Creek and Woods Canyon and the West boundary ¼ mile west of Long Creek. The following sections are included in the proposal (see alternative maps in chapter II):

T10S, R7W, SECTIONS 33, 34
T10S, R8W, SECTIONS 10,11,15,16,20,21,22

B. TEMPORAL BOUNDARY

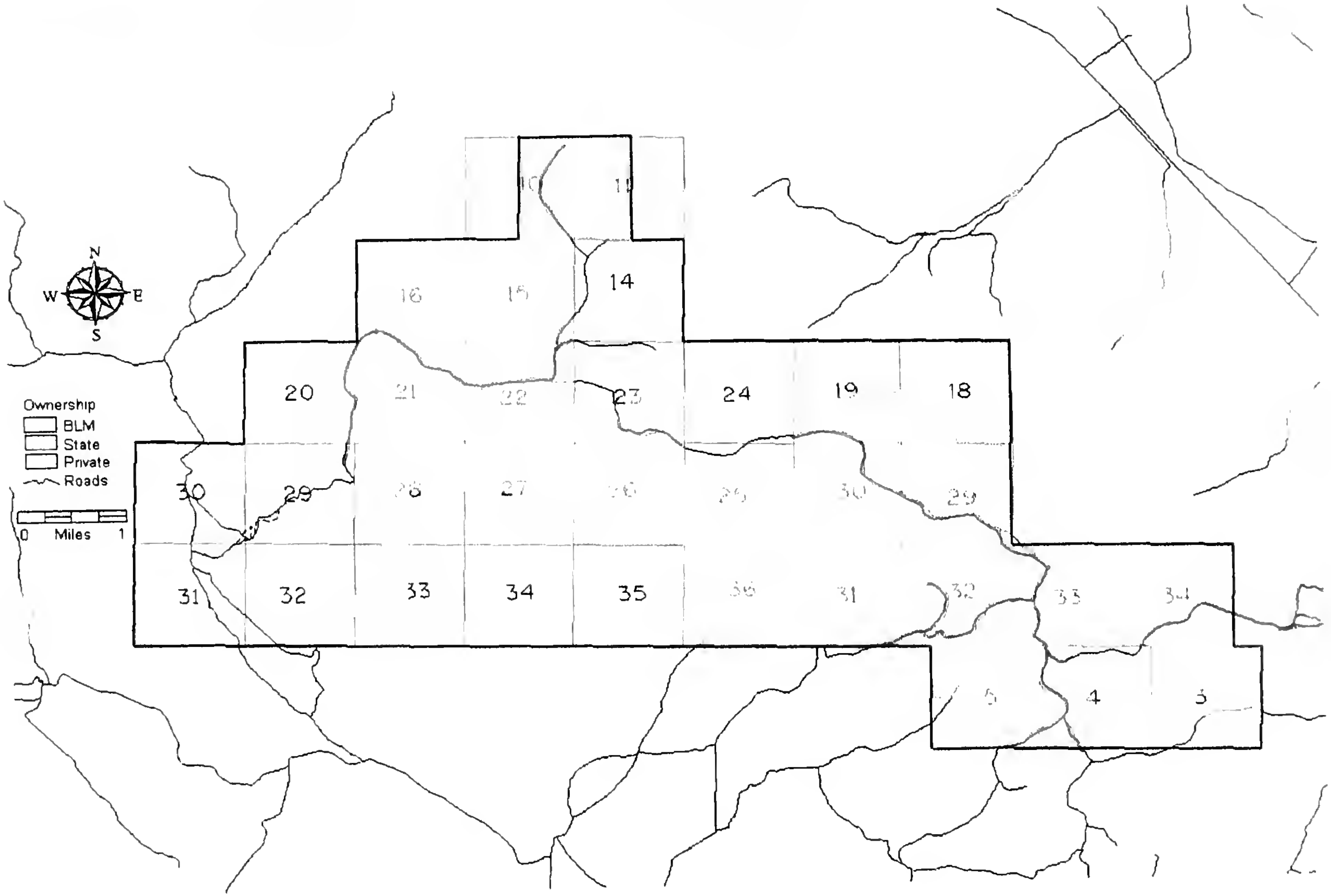
Under the proposed action, the timber would likely be sold in 1999. Harvesting and road improvements could take place over a four-year period. Fire hazard reduction activities would be completed two years after harvest. Specific operational periods would be required within each calendar year for individual activities, such as culvert installations, road construction, and timber harvest to reduce environmental impacts associated with some resources.

III. CONNECTED AND CUMULATIVE ACTIONS

Connected actions include post-harvest fire hazard reduction (slash treatment), road construction and closure activities, grass seeding and rehabilitation of landings. Cumulative past and foreseeable future actions within the project area include wildfire suppression, timber harvesting, livestock grazing on State and private lands, reforestation, grazing and recreational use.

Whenever possible connected and cumulative actions have been evaluated in each resource description.

LAND OWNERSHIP MAP INDICATING THE PROJECT AREA AND EXISTING ROADS



IV. OTHER KNOWN ENVIRONMENTAL ASSESSMENTS THAT MAY INFLUENCE THE PROJECT PROPOSAL

In June 1996, DNRC began a phased-in implementation of the State Forest Land Management Plan (Plan). The Plan established the agency's philosophy for the management of forested state trust land. The management direction provided in the plan comprises the framework within which specific project planning and activities take place. The Plan also defines the Resource Management Standards that guided the development of this proposed action. The Plan philosophy and appropriate resource management standards have been incorporated into the design of the proposed action.

Within the project area an EA was prepared for the Price Canyon Timber Sale in 1993. This project harvested 213 mbf in a selective harvest from 45 acres in Section 3, T11S, R07W.

An EIS was completed for the West/Middle Fork Blacktail Timber Sale in 1998. This sale is located approximately 8 miles SE of the project area and is expected to remove 5.1 mmbf in a selective harvest from 1,156 acres. The timber from this sale is planned for harvest by 2003.

V. OTHER AGENCIES WITH JURISDICTION AND PERMITS REQUIRED

A. A Stream Preservation Act Permit (124 Permit) is required for activities conducted by any government agency in a stream. Activities such as culvert installation or bridge construction requires a "124" permit. All action alternatives propose a ford crossing on Divide Creek and a an improved crossing on Long Creek that would require a 124 permit. Alternatives B and C propose two culvert crossings on tributaries of Cottonwood Creek that would require a 124 permit. Alternatives A, B, and D propose a culvert crossing on a stream in Riley Canyon that would require a 124 permit.

B. A Short-term Exemption from Montana's Surface Water Quality Standards (3A Authorization) is needed whenever activities cause unavoidable short term violations of state surface water quality standards for turbidity, total dissolved solids or temperature. This permit from Montana Department of Environmental Quality is occasionally needed for some culvert placements, however, a 3A Authorization is not anticipated for activities proposed in any of these alternatives.

C. Slash burning activities are regulated and air quality is monitored through the Montana Airshed Group, of which DNRC is a member.

D. A Road Use permit is required by the Bureau of Land Management for roads located on BLM ownership.

E. Temporary road easements are required from three private landowners.

VII. DECISIONS TO BE MADE

A Record of Decision will be published with the adoption of a final EIS and will include the following:

1) A decision on which alternative to implement,
2) Any special conditions under which one selected alternative is to be implemented.
3) Reasons for the decision

VIII. RESOURCE ISSUES AND CONCERNS

Resource concerns were identified through scoping and during data collection phases of the analysis. Resource concerns and issues were brought to our attention by the general public, other natural resource agencies, various organizations and internally from DNRC natural resource specialists and land managers. Input opportunities for the public were ongoing throughout the analysis and included the initial project proposal (mailing and news ads) mailing of issue statements, correspondence by mail and a thirty-day public review period for the draft EIS. A list of all correspondence and concerns received by DNRC is available in the project file.

As a matter of course, all timber sales designed by DNRC incorporate many routine mitigation measures to reduce impacts, resolve issues, and address resource concerns. Some of the other issues and concerns we received are outside the scope of the proposed action because they are either not pertinent to the decision, already decided by law or DNRC standards, beyond the geographical influence, or have nothing to do with the proposal.

Issues that were either controversial or represented unresolved conflicts were used to design alternatives to the proposed action. Following are the major environmental issues addressed in the effects analysis. See the project file, for a further description of issue statement development.

Below is a list of major environmental issues:

A. WATER QUALITY AND WATER YIELD

There is concern that the timbers harvest and road maintenance activities conducted under the proposed sale would increase sediment levels in the creek drainages and consequently affect water quality. The cumulative impacts of past and proposed timber harvests in this vicinity on sedimentation and water yield are also a concern.

B. FISHERIES

Long Creek, Divide Creek, and Cottonwood Creek support fish populations. Cottonwood Creek supports a population of 98% genetically pure westslope cutthroat trout. There is concern the timber sale activity will impact the fish habitat in these streams.

C. OLD GROWTH AND ASSOCIATED SPECIES

There is concern that the proposed timber sale would impact old growth stands in the area and consequently plant and wildlife species that are associated with old growth forested stands.

D. THREATENED AND ENDANGERED SPECIES

The Blacktail Mountains provide possible habitat for the threatened grizzly bear and the endangered bald eagle, gray wolf and peregrine falcon. There was concern regarding potential impacts to these species.

E. ECONOMICS

Concern has been expressed that the expense of road development and harvest operations would exceed the timber value and result in little monetary return to the Trust.

F. BULL ELK VULNERABILITY

There is concern that a timber harvest in the area may cause a reduction of elk security cover and an increase in hunter access, both of which increase bull elk vulnerability. Specifically, loss of hiding cover and increased access may increase the number of bull elk harvested during the first week of the hunting season, and would consequently require the MDFWP to further restrict hunter opportunity in the area.

G. ROADS

This issue relates to the development, condition, extent, and type of construction of new and existing roads in the area. Public involvement has identified a concern that new roads could cause multiple potential impacts associated with the construction, development, and use of forested roads. Some of the associated impacts include sedimentation, increased traffic, spread of noxious weeds, and increased access for recreational purposes.

H. OTHER SENSITIVE SPECIES

There are several wildlife species identified as "sensitive" by DNRC that may use the Blacktail Mountain vicinity and surrounding area. There is concern that the proposed harvest may have unacceptable impacts to those species.

I. WINTER RANGE

It was asked if harvesting timber in the Blacktail Mountain area would have an adverse effect on wintering big game species such as deer, moose, and elk.

CHAPTER II
ALTERNATIVES

I. INTRODUCTION

Chapter II explains how alternatives were developed, describes the three action alternatives, the No-Action Alternative, and the alternatives that were considered but not given detailed study. Chapter II also summarizes environmental effects from chapter IV in a comparison table.

II. DEVELOPMENT OF ALTERNATIVES

A. INITIAL PROPOSAL

This proposal was initiated by the planning process DNRC uses to provide a listing of future timber sale proposals. Areas of possible harvest are selected using a wide range of management and resource-related considerations, including, among others, sale volume targets, salvage of insect and disease infestations, accessibility, and environmental and biodiversity considerations.

B. INITIAL SCOPING

An informational letter containing the project objectives, proposed management activities and a map of the project area was developed. The letter and a map were sent out to individuals, interested groups, adjacent landowners, other agencies and DNRC resource specialists on December 23, 1996. A public notice was put in the Dillon Tribune on February 3, 1997 and again on February 10, 1997. Comments received were compiled and analyzed to provide the initial concerns and issues.

C. PUBLIC INPUT

Public comment from the scoping letters was requested by January 31, 1997 and comment from the Public Notice in the newspaper was requested by February 28, 1997. Comments were received in writing and by telephone. Comments received from the Montana Department of Fish, Wildlife, and Parks indicated a timber harvest in this area may conflict with their goals and plans for elk management in the Gravelly Elk Management Unit. One of the criteria for preparing an EIS under MEPA rules, is if the proposed action conflicts with formal plans of another State Agency, consequently an EIS has been prepared.

D. DEVELOPING ALTERNATIVES

The issues identified during the scoping process are summarized in Chapter I. Some issues led to the development of mitigation measures that can be incorporated into all alternatives. Others became the primary concern for developing an alternative.

A helicopter yarding alternative is being considered because it would harvest a substantial volume of timber with a minimum amount of road development and soil disturbance.

A traditional ground skidding alternative is being considered due to the concern regarding helicopter yarding expense. A ground-based sale would harvest less timber but may provide greater trust revenue.

An alternative was developed that would not harvest in the Cottonwood Creek drainage where 98% genetically pure westslope cutthroat trout are present.

An alternative was developed that would not harvest in Green or Riley Canyons to preserve old growth stands in these areas.

The No Action Alternative is evaluated as the basis for comparing the other alternatives to the option for not conducting the project.

III. DESCRIPTION OF ALTERNATIVES

A. MITIGATIVE MEASURES COMMON TO ALL ACTION ALTERNATIVES

1. Most new road construction is primarily designed to be temporary and of minimum standard and shall be physically closed, at specific locations so they are impassable by a motorized vehicle at the end of the sale. Logging slash and brush will be used when available to discourage foot traffic along its right-of-way, then seeded with weed free grass seed.

2. Road reconditioning and reconstruction across private lands would bring the existing haul routes up to BMP standards. The majority of this reconditioning and/or reconstruction would consist of minor blading where necessary and road drainage improvements where needed to reduce potential sedimentation that is currently occurring.

3. All access through private land would be temporary for the sole purpose of implementing this proposal and is not designed for public access purposes.

4. Protection for any improvements within the gross sale area is provided in the timber sale contract. Improvement protection includes the immediate replacement of any damaged fence or roads.

5. Soil scarification for adequate seedbed preparations would be kept to a minimum to limit potential soil and watershed impacts. Scarification is expected to range from 5 to 45%.

6. Up to 20 tons per acre of slash and woody debris greater than 3" in diameter would be left for nutrient recycling, and soil wood recruitment to maintain soil productivity, seedling micro-climate, habitat for some species of small mammals, and old growth stand characteristics.

7. Road construction will be minimized and located on most stable ground feasible. All proposed road construction will be reviewed by the soils scientist for site specific mitigation designed to maintain slope stability.

8. Road use and equipment operations during harvest and post harvest activities will be limited to dry, frozen or snow covered conditions.

9. Road drainage will be installed concurrent with construction and will be maintained throughout the course of the sale.

10. Slash disposal methods would be limited to spot piling, whole tree skidding, lop and scatter and jackpot burning to minimize compaction and soil displacement.

11. Money will be collected from the purchaser for the treatment of noxious weeds. All off road equipment used in the sale area would be power washed and inspected before being brought on-site.

12. All newly disturbed soils on road cuts and fills would be promptly reseeded to site adapted grasses, including native species, to reduce weed encroachment and stabilize roads from erosion.

13. DNRC would monitor the project area for two years after completion of harvest to identify if noxious weeds occur on the site. If noxious weeds occur, a weed treatment plan will be developed and implemented to eradicate the weeds.

14. All current Best Management Practices (BMP'S) would be implemented as they pertain to all action alternatives of this EIS.

15. All current Streamside Management Zones (SMZ) laws and procedures would be followed as they pertain to all action alternatives. No harvest would occur within the SMZ.

16. If Cultural Resources, Sensitive Species, or Threatened and Endangered species are found in the area, the project would be suspended, pending further analysis by appropriate resource specialists.

17. If an active wolf den or rendezvous site were discovered within one mile of the harvest activity, operations would be suspended pending further analysis by an appropriate resource specialist.

18. If large aggregations of bats are discovered in the project are during sale preparation or administration, the Forest Management Wildlife Biologist will be notified and appropriate mitigation measures developed.

19. Snags will be retained to the fullest extent possible that does not jeopardize safety. Firewood permits (if any) would be issued only for wood in slash piles.

20. An unharvested buffer strip one to two chains in width would be left around the perimeter of harvest areas to promote screening for elk and other wildlife security, and for wind protection.

21. Timber Harvest would not be allowed during the general hunting season to avoid conflicts with recreational use. The season of operation is constrained to the period from July 1, to October 15. This period avoids denning and calving dates

for several wildlife species and avoids conflicts with the general big game hunting season.

B. Alternatives Considered in Detail

In all harvest alternatives group shelterwood treatments would be implemented in spruce /fir stands to regenerate the stands in a manner consistent with the natural stand dynamics that would maintain the stand over time. Approximately 118 acres of primarily spruce-fir stands would be treated through the group shelterwood system. Harvested groups would be 1 to 2 tree lengths in diameter (approximately ¼ to ½ acre in size) scattered throughout the stand, actually harvesting a total of approximately 25% of the stand area. This treatment would also minimize risk of windthrow and frost pockets (Alexander, 1987).

Douglas fir stands would be selectively cut to remove over mature, overstocked, slow growing or damaged Douglas fir, or be harvested through a shelterwood/seedtree treatment. On an estimated 149 acres of primarily Douglas fir timber type harvest would remove approximately 50% of the volume leaving the residual stand with approximately 35 trees per acre that are >7 inches in diameter with only a few (1 to three per acre) larger diameter (>19") trees that are scattered throughout. On approximately 63 acres of primarily Douglas fir timber type harvest would remove approximately 70% of the volume so that the residual stand would consist of approximately 14 to 20 trees per acre, consisting of dominant Douglas fir over 16" dbh that are greater than 170 years old. The remaining stands would contain patches of submerchantable seedling, sapling or pole sized material.

In the stand with a mixed Douglas Fir/Lodgepole Pine cover type, most of the Lodgepole Pine (LPP) would be removed from the interior of the stand to promote LPP regeneration, and Douglas Fir left to provide a seed source to promote a mixed species stand. An estimated 46 acres of lodgepole pine timber type would have all lodgepole removed and leave a residual stand of approximately 5 Douglas fir and Engelmann spruce trees per acre. A one to two chain width unharvested buffer area would be left around the outside margin of the stand

1. Alternative - A

This alternative was developed in response to concerns to reduce the amount of new road construction, and to address concerns of possible impacts of steam crossing on the 98% genetically pure westslope cutthroat trout in Cottonwood Creek. The alternative would harvest an estimated 2.3 MMBF of timber on approximately 376 acres. The harvest would include 10 harvest units in Sections 10, 11, 15, 16, 20, 21, and 22, Township 10 South, Range 08 West, and Sections 33 and 34 Township 10 South, Range 07 West. Conventional yarding would be utilized in four units (Units 2,3,4 and 7) which are well suited for ground based systems. Helicopter yarding would be utilized in six units (Units 1,5,8,9,10 and 11).

Under this proposal an estimated 2.0 miles of new road would be constructed. Approximately 8.8 miles of existing roads would receive minor improvements to the road surface and drainage features. In addition, 5.3 miles of existing road would be relocated to avoid steep grades and eliminate drainage and possible sedimentation problems. All road construction and harvest activity could be conducted from July 1 through October 15 each year the timber contract is in effect. All new roads would be closed at the conclusion of the sale, along with most roads replaced by reconstruction, resulting in a net increase of 1.5 miles of road. Licensed grazing and recreational activities would continue.

2. Alternative - B

This alternative is the initial proposal that was distributed for scoping and issue identification. An estimated 2.1 MMBF of timber would be harvested from approximately 340 acres. The harvest would include seven cutting units located in Sections 10, 11, 15, 16, 21, and 22, Township 10 South, Range 08 West, and Sections 33 and 34 Township 10 South, Range 07 West. Traditional ground skidding would be used in all but three units (2,5 and 8) that would be cable yarded.

Under this proposal an estimated 5.5 miles of new road would be constructed. Approximately 8.8 miles of existing roads would receive minor improvements to the road surface and drainage features. In addition, 5.3 miles of existing road would be relocated to avoid steep grades and eliminate drainage and possible sedimentation problems. The road construction and harvest activity would be conducted from July 1 through October 15 each year the sale contract is in effect. All new roads would be closed at the conclusion of the sale, along with most roads replaced by reconstruction, resulting in a net increase of 1.5 miles of road. Licensed grazing and recreational activities would continue.

3. Alternative - C

This alternative was developed in response to concerns expressed relating to harvest in unit 7, which has old growth characteristics. Under this alternative, no harvest would occur in this stand.

The alternative would harvest an estimated 1.7 MMBF of timber on 283 acres. The harvest would include six cutting units located in Sections 15, 16, 21, and 22, Township 10 South, Range 08 West, and Sections 33 and 34 Township 10 South, Range 07 West. No harvesting would occur in Sections 10 or 11, Township 10 South, Range 08 West.

Under this proposal, an estimated 4.1 miles of new road would be constructed to access the harvest units. Approximately 8.0 miles of existing roads would receive minor improvements to the road surface and drainage features. In addition, 3.8 miles of existing road would be relocated to avoid steep grades and eliminate drainage and possible sedimentation problems. All road construction and harvest activity could be conducted from July 1 though Oct. 15 each year of the timber

contract. All new roads would be closed at the conclusion of the sale, along with most roads replaced by reconstruction, resulting in a net increase of 1.5 miles of road. Licensed grazing and recreational activities would continue.

4. Alternative - D

In response to concerns regarding possible impacts to 98% genetically pure Westslope Cutthroat Trout, an alternative was developed in which no harvesting would occur in the Cottonwood Creek drainage. Under this alternative, the harvest would include six cutting units located in Sections 10, 11, 15, 16, 21, and 22, Township 10 South, Range 08 West. No harvesting would occur in Sections 33 and 34 Township 10 South, Range 07 West.

Under this alternative, approximately 1.4 MMBF of timber would be harvested from 285 acres. Traditional ground skidding would be used in all but two units (2 and 5) that would be cable yarded.

3.8 miles of new road would be constructed under this alternative. Approximately 8.0 miles of existing roads would receive minor improvements to the road surface and drainage features. In addition, 4.2 miles of existing road would be relocated to avoid steep grades and eliminate drainage and possible sedimentation problems. All road construction and harvest activity could be conducted from July 1 through October 15 each year the sale contract is in effect. All new roads would be closed at the conclusion of the sale, along with most roads replaced by reconstruction, resulting in a net increase of 1.2 miles of road. Licensed grazing and recreational activities would continue.

5. Alternative - E (No Action)

No timber harvest, road construction or road improvement activity would be conducted under this alternative. No timber revenue would be generated and the site would not be expected to be reevaluated for timber harvest until the existing circumstances change. Licensed grazing and recreational activities would continue.

Table II-1: Proposed Activities by Alternative

ALTERNATIVE	MMBF	TREATED ACRES	NEW ROAD CONSTRUCTION (miles)	ROAD IMPROVEMENT (miles)	ROAD RELOCATION (miles)
A-	2.3	376	2.0	8.8	5.3
B-	2.1	340	5.5	8.8	5.3
C-	1.7	283	4.1	8.0	3.8
D-	1.4	285	3.8	8.0	4.2
E- No Action	0.00	0.00	0.00	0.00	0.00

C. ALTERNATIVES CONSIDERED BUT NOT GIVEN DETAILED STUDY:

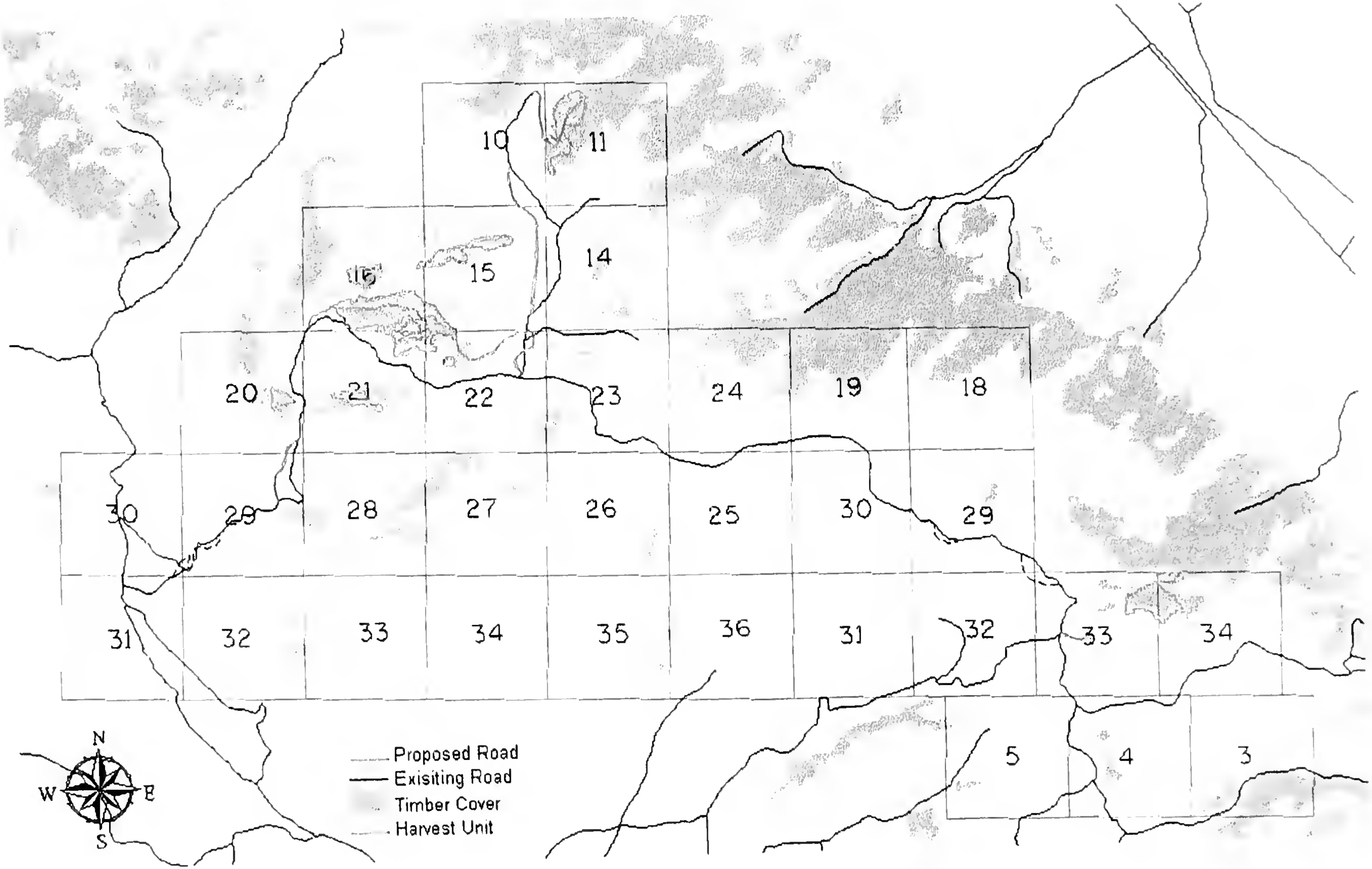
1. Defer Harvest for Compensation - Due to concerns expressed by the Montana Department of Fish, Wildlife and Parks regarding Bull Elk vulnerability and their inability to meet their management objectives, the DNRC asked MDFWP if they would compensate the trust to defer the timber harvest. The MDFWP has declined to consider such an option.

2. A Unit #6 at the head of Green Canyon was considered in the original proposal but has been dropped due to the heavy elk use in this stand, it's old growth values and localized areas of marginal slope stability.

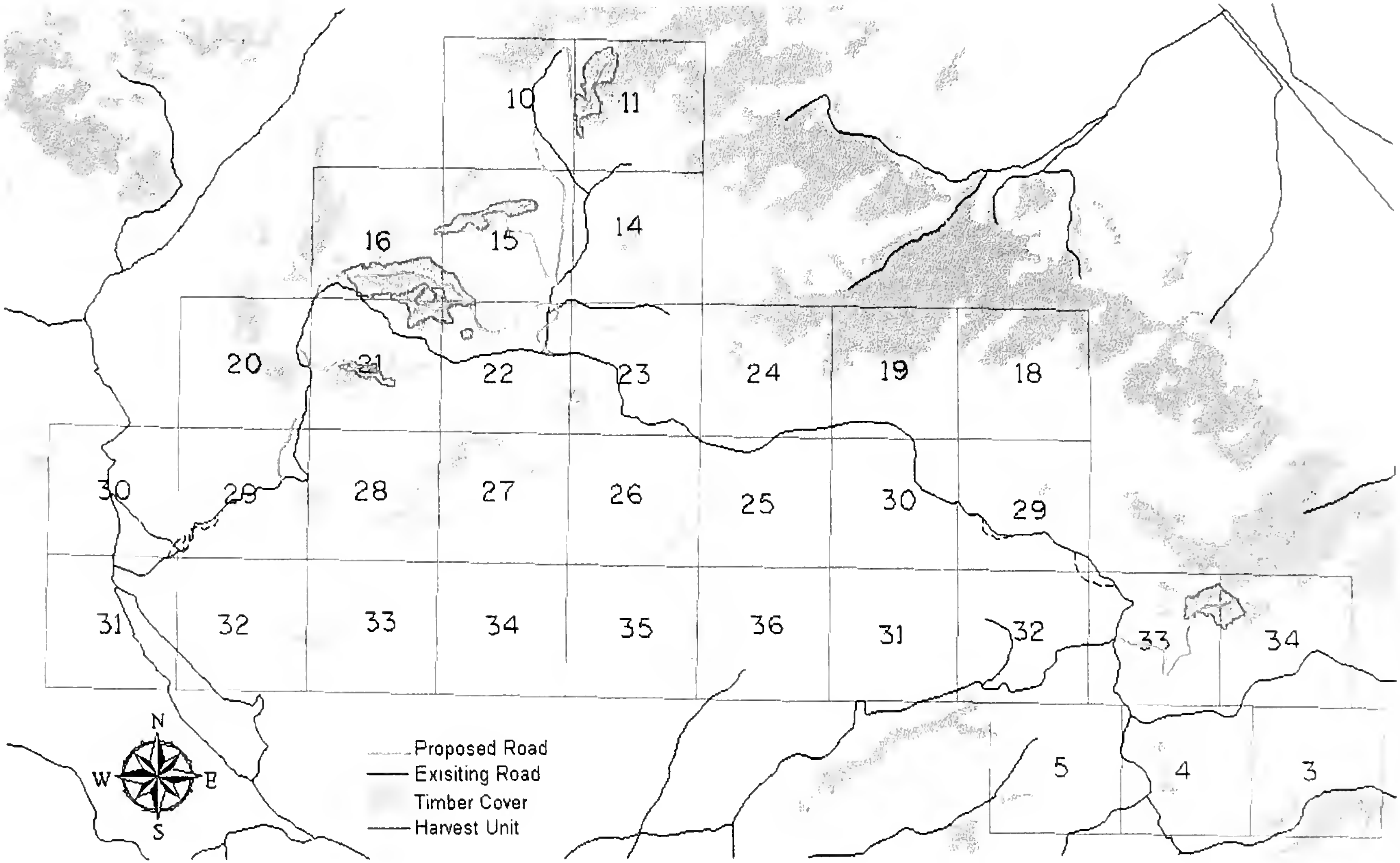
3. Additionally considered for harvest were small stringers of timber along draws. These areas were dropped from further consideration due to extensive road building for a small volume, and due to possible sediment concerns in streams containing westslope cutthroat trout.

4. Other forested areas on these tracts were originally considered, but dropped from further consideration due to extensive road building for a small volume, or high cost per volume for helicopter yarding.

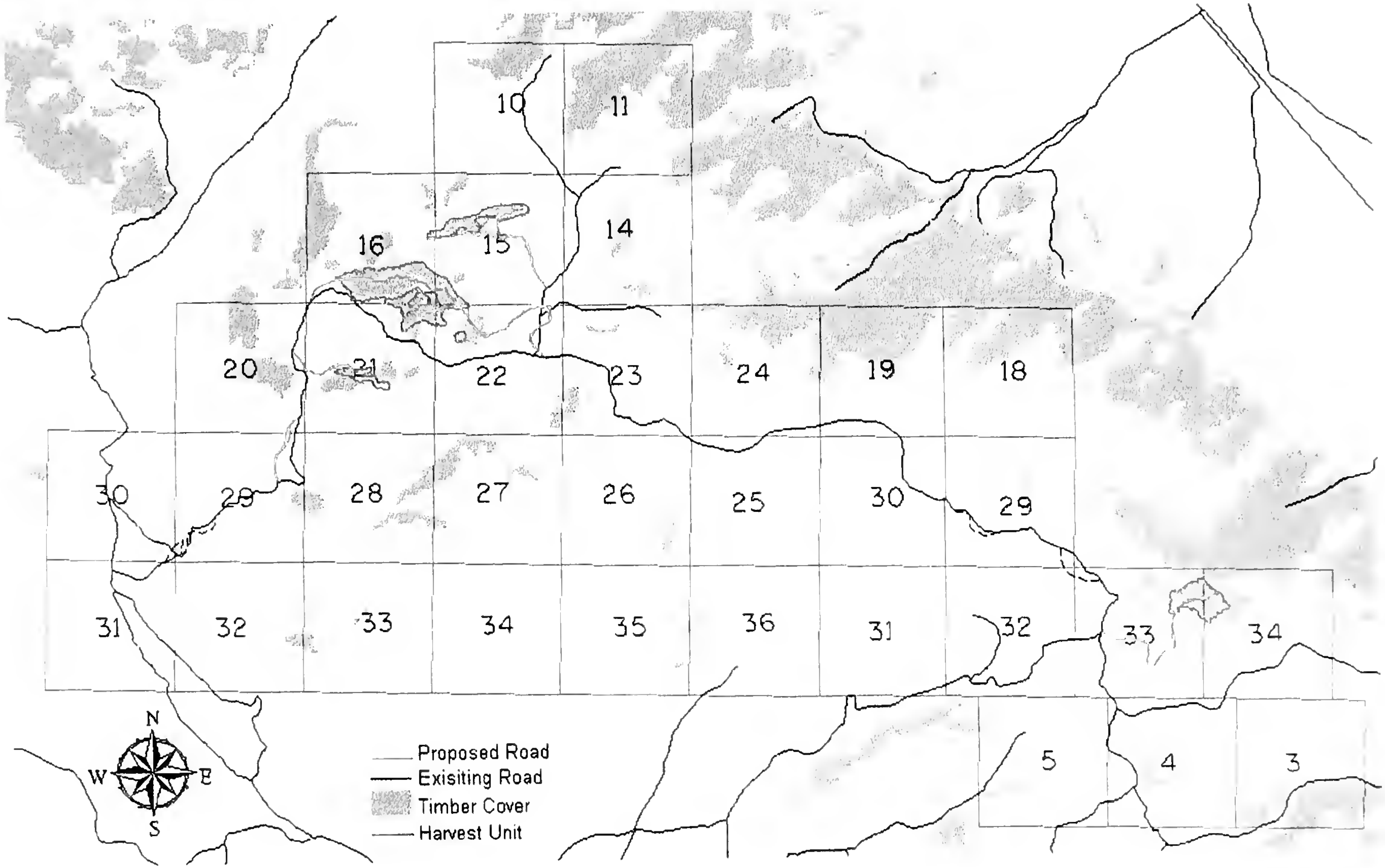
ALTERNATIVE A



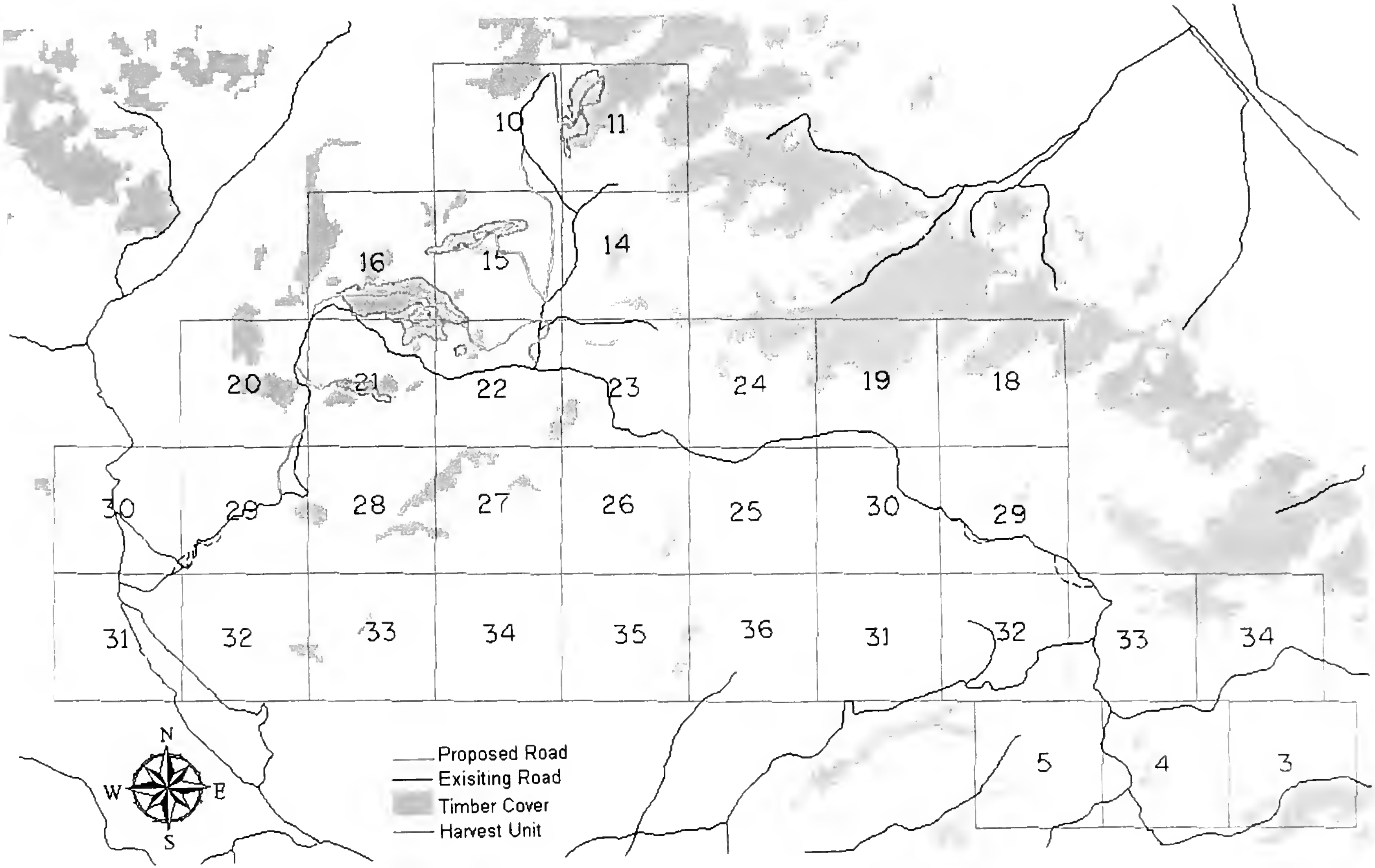
ALTERNATIVE B



ALTERNATIVE C



ALTERNATIVE D



Comparison of alternatives table

<table>
<tr><th>Proposed Activity or Environmental Component</th><th>Alternative A</th><th>Alternative B</th><th>Alternative C</th><th>Alternative D</th><th>No Action</th></tr>
<tr><td>Estimated Harvest Volume</td><td>2.3 mmbf</td><td>2.1 mmbf</td><td>1.7 mmbf</td><td>1.4 mmbf</td><td>0</td></tr>
<tr><td>Forested Acres Treated</td><td>376 acres</td><td>340 acres</td><td>283 acres</td><td>285 acres</td><td>0 acres</td></tr>
<tr><td>Miles New Road Constructon</td><td>2.0 miles</td><td>5.5 miles</td><td>4.1 miles</td><td>3.8 miles</td><td>0 miles</td></tr>
<tr><td>Miles New Road Closed</td><td>2.0 miles</td><td>5.5 miles</td><td>4.1 miles</td><td>3.8 miles</td><td>0 miles</td></tr>
<tr><td>Miles of Existing Road Relocated</td><td>5.3 miles</td><td>5.3 miles</td><td>3.8 miles</td><td>4.2 miles</td><td>0 miles</td></tr>
<tr><td colspan="6">Impacts to Vegetation</td></tr>
<tr><td>Cover Types</td><td colspan="4">No fundamental change in cover types. Shade tolerant species reduced on acres harvested.</td><td>Very slow increase of Spruce/fir cover type over time</td></tr>
<tr><td>Successional Stages</td><td colspan="3">Seedling/sapling stage increased by 109 acres</td><td>Seedling/sapling stage increased by 46 acres</td><td>Slow trend toward climax. Forests remain older than would be expected.</td></tr>
<tr><td>Old Growth</td><td colspan="3">The acreage of old growth in the project area would be reduced from 946 acres to 837 acres. The 258 acres of high attribute old growth would be decreased by 22 acres.</td><td>The acres of old growth would be reduced from 946 acres to 900 acres. The 258 acres of old growth with a high degree of old growth attributes would not be decreased.</td><td>The acreage of old growth would slowly increase from the current 946 acres.</td></tr>
</table>

Proposed Activity or Environmental Component	Alternative A	Alternative B	Alternative C	Alternative D	No Action
Insect and Disease	Reduced susceptibility to spruce budworm on treated acres. Reduced susceptibility and mortality from dwarf mistletoe on 46 acres of lodgepole pine. Slight reduction or possible increase of spruce bark beetle infestations. Reduced mortality expected from western balsam bark beetle due to reduction of subalpine fir component.				Mortality from all insect and disease infestations expected to slowly increase as stands age.
Sensitive plants	No impacts anticipated .				
Impacts to Watershed and Fisheries					
Water Yield	No detectable increase in water yield				No increase in water yield
Sedimentation	Improvements to roads and stream crossings are expected to reduce long term sedimentation.				Existing sediment sources(particularly roads) would continue to deliver sediment
Westslope Cutthroat Trout	Low potential for impacts to trout because minor road construction would take place in Cottonwood drainage and units would be helicopter yarded.	Highest potential for impacts to trout due to road construction, culvert installations and ground based skidding in Cottonwood drainage.		No impact to trout since units in Cottonwood drainage are not included in the sale.	No impacts to Westslope Cutthroat Trout.

Proposed Activity or Environmental Component	Alternative A	Alternative B	Alternative C	Alternative D	No Action
Impacts to Wildlife					
Landscape Characteristics	Slow encroachment of forest into grasslands. Very long term increase in forest cover due to fire suppression. Forest interior conditions reduced over the harvested acres.				Slow encroachment into grasslands. Very long term increase in forest cover due to fire suppression.
Old Growth Attributes	Snag abundance and large woody debris decrease under all alternatives. However, mitigations incorporated in the design of the sale are expected to retain snag and woody debris components, albeit to a lesser degree.				Snag abundance and large woody debris remains moderately available
Peregrine Falcon	No impacts anticipated				
Wolf	Very small increase in open road density (.05 miles/sq. mile) results in slight negative impact to potential wolf populations				No impacts
Ferruginous Hawk	No impacts				
Boreal owl	Ample nesting habitat expected to be maintained under all action alternatives. Foraging habitat expected to increase in the short term but decrease in the long term.				No impacts
Townsend Big Eared Bat	No measurable change anticipated.				
Blackbacked Woodpecker	Minor and indirect reduction of habitat due to reduced potential of fire occurrence.				Low habitat value until fire occurs. Moderate high probability of fire occurrence.
Elk Habitat	Impacts are not anticipated to winter range or calving grounds. Some temporary displacement may occur during logging operations particularly with helicopter yarding in Alternative A.				No Impacts

PROPOSED ACTIVITY OR ENVIRONMENTAL COMPONENT	Alternative A	Alternative B	Alternative C	Alternative D	No Action
Elk Security Outside of Hunting Season	Loss of security cover on 109 acres (5.4%) of forested area within project area. Open road density remains at less than 1 mile per square mile.			Loss of security cover on 46 acres (2.2%) of forested area. Road density remains at less than 1 mile/sq mile.	No change in habitat effectiveness.
Impacts to Bull Elk Vulnerability					
Hillis Security Areas	No change under all Alternatives. Security areas remain limited (zero in small analysis area and 12.4% in Large Analysis Area).				
Forest Cover	Forest cover decreased by 109 acres (5.4% of forest cover). Forest Area reduced from 9.8% of project area to 9.3%. Cover value is reduced on additional 267 acres (13.3% of forest area).	Forest cover decreased by 109 acres. Cover value reduced on additional 231 acres (11.5 % of forest area).	Forest cover decreased by 109 acres. Cover value reduced on additional 174 acres (8.6% of forest area).	Forest cover decreased by 46 acres (2% of forest cover). Forest area reduced from 9.8% of project area to 9.6%. Cover value reduced on additional 239 acres (12% of forest area).	Forest cover remains on 9.8% of the project area and 25% of the Large Analysis area.
Impacts to Recreation	No change to other recreational uses anticipated.				
Impacts to Grazing	No change to terms of the grazing leases anticipated.				
Impacts to Economics	Timber harvest revenue--$117,300. Grazing revenue remains at average--$13,327 per year.	Timber harvest revenue--$205, 800. Grazing revenue remains at average--$13,327/year.	Timber harvest revenue--$151,300. Grazing revenue remains at average--$13,327/year.	Timber harvest revenue--$158,200. Grazing revenue remains at average-$13,327/year.	No Timber harvest revenue. Grazing revenue remains at $13,327/year.

CHAPTER III
AFFECTED ENVIRONMENT

This chapter describes the environment within which the proposed action would occur. It serves as a baseline against which action alternatives may be compared. The Affected Environment describes the area and its relationships to the issues identified in Chapter II.

I. GENERAL DESCRIPTION:

The Long/Cotton Timber Sale is in Southwest Montana, approximately 18 air miles southeast of Dillon, Montana. The project area lies in the Blacktail Mountains from approximately 7,000 to 9,000 feet elevation. The Bureau of Land Management (Dillon Resource Area) and private land border the state ownership. The total estimated acreage in the project area including state, federal and private land is 20,371 acres.

TABLE III-1: Total acres, forested acres, and non-forested acres in the project area by land ownership.

OWNERSHIP	FORESTED ACRES	NON-FORESTED ACRES	TOTAL ACRES
STATE LAND	1,194 ACRES	10,477 ACRES	11,671 ACRES
BLM	649 ACRES	4,651 ACRES	5,300 ACRES
PRIVATE	163 ACRES	3,237 ACRES	3,400 ACRES
TOTAL	2,006 ACRES	18,365 ACRES	20,371 ACRES

The Blacktail Mountains are a remote range consisting primarily of open rangeland with scattered timber on the north facing slopes.

The primary land use is livestock grazing (mostly cattle) conducted under grazing leases administered by the private landowners, the BLM and DNRC. Grazing activity is conducted from June through September.

Recreational use of the area is limited due to the remote location and travel distance from the major population centers. Most recreational use is associated with big game hunting during the general hunting season, from mid October through the end of November. The area is generally inaccessible during the winter months. Occasionally, recreational activities such as wood gathering and camping are conducted during the period from June through September, but use is extremely light.

The closest year-round residence is on Sage Creek, more than 5 miles from the project area. Since the road is not maintained in the winter, snowmobile travel is the only feasible way to access the area in the winter months.

II. VEGETATION:

A. Forest Types, Successional Stages and Fire History:

1. Forest Types and Fire History

The area forests are composed of three primary timber cover types located mostly on north facing slopes. Of the current forest area in the sections where sale units are located, 72% is classified as primarily Douglas fir, 5% as lodgepole pine, and 23% as spruce-fir.

The present Douglas-fir stands are mostly multi-storied with trees ranging in age from 10 to 200+ years. The older trees in the stands are relicts that have survived past wildfires. Historically, fires appear to have been underburns that killed most regeneration and sapling size trees, leaving larger diameter trees in a more open stand than exists today. The current understory layers are likely a result of wildfire control during the 20th century. The lack of underburns has allowed regeneration to survive and grow into a multi-storied stand. The two Douglas-fir habitat types that make up the bulk of the area in the proposed harvest units are PSME/ARCO and PSME/CARU. These habitat types are listed in Fire Group 5 and 6 (Fischer and Clayton 1983). Arno and Gruell, (1983) estimate a Group 5 mean fire interval of 35 to 40 years in pre-settlement southwest Montana stands, and a mean fire interval of 42 years for pre--settlement stands in Group 6. The lack of fires has also allowed the Douglas-fir forest to encroach on the montane grassland and the sage steppe in the area. Most Douglas-fir stands in the area show evidence of this encroachment.

The Engelmann spruce cover type is the second most prevalent in the area and is located in the creek bottoms, and on terraced ground on north facing slopes that hold moisture. It is primarily associated with the ABLA/ARCO habitat type. Since Engelmann spruce is a long lived seral species, it would not be expected to be a codominant in the true climax cover type, being replaced over time with subalpine fir, unless disturbances maintain this component. Fire would not be a frequent disturbance factor for this stand, given the NE facing slope and high elevation. Fire intervals would be expected to be long. Fischer and Clayton, (1983) estimate a fire interval of 70 to 300 years for fire group eight for stand replacement type fires, with small underburns from fires which remain small with a low intensity creating small disturbance patches ranging in size from single tree to ½ acre. Disturbance from windthrow could also create small patches ¼ - ½ acre in size within the stand. Single tree or group mortality of trees could also be expected from bark beetle activity.

The third prevalent timber cover type in the area is lodgepole pine on ABLA/ARCO habitat types. There are two stands, located on sites with soils formed from gniess and schist parent materials, which are predominately even-aged, resulting from stand replacing fires. One of the lodgepole stands in the area is approximately 60 years old composed of trees with an average dbh of 4". The other lodgepole stand is composed of trees 130 years of age, with scattered trees approximately 190 years old around the margins of the stands where past fires burned less severely.

The emphasis on fire suppression the past 85 years has limited the natural role of fire in forest development in the Project Area. Ground fires have normally been suppressed as quickly as possible, allowing a build-up of fuels over time. There was no evidence of fire in recent decades. Mortality from insect and disease infestations has contributed to heavy fuel loadings that, if ignited, would likely surpass conventional wildfire initial attack capabilities. Aspen is uncommon and may have suffered from fire exclusion.

Continued fire suppression efforts have apparently led to an increase in forest cover generally and in the Blacktail Range over the past 100 years. Comparisons of photos taken in the early 1900s with photos taken in the 1980's (Gruell 1983) suggest a substantial increase in forest cover.

2. Successional Stages

Within climatic sections of Montana, Losensky (1997) estimated the age structure of each forest cover type that may have existed in 1900 by backdating inventory data. The Blacktail Mountain area falls under Losensky's (1997) climatic section 13 (Section M332E), which encompasses the southwest corner of Montana and the upper Salmon and Lemhi drainages in Idaho, and includes Beaverhead, and Madison Counties, and parts of Silverbow, Deerlodge, and Jefferson Counties. In this climatic section, forested cover types were historically found on about 39% of the area, with the remainder being grassland and shrubland. He determined that at the turn of the century, 10% of the timber in the climatic section was in old growth, while 19% of Beaverhead and Madison County timber was in old growth.

Current forest inventory data on State lands in Beaverhead and Madison Counties can be used to compare the current age structure of each forest cover type to Losensky's evaluation of conditions that existed in 1900. We do not have a complete stand level inventory of all forested State lands in Beaverhead or Madison County. An estimate of age structure is available on approximately 63% of the forested State lands. However, the data available is on the majority of lands that have potential for timber harvest activity and therefore would tend to represent stands that have had human caused disturbance and consequently younger age classes. Table III-2 displays Losensky's estimate and the current inventory estimate of age structure on forested state land in Beaverhead and Madison Counties. Comparison of the data in Table III-2 indicates the current age structure of forested State lands is substantially older than would be expected from Losensky's data. Currently approximately 57% of the forested stands on State lands are greater than 100 years in age. There also currently is a greater than expected percentage (40%) of old growth on State land when compared to the historic estimate of 19% on all lands in 1900. The older stand structure is consistent with the belief that modern fire suppression policies have limited the natural disturbance role played by fire in this region and that human caused disturbance has not approached historic levels of disturbance.

Table III-2: Percentages of area by cover type and age class. Historic figures are from Losensky (1997) and represent an estimate of conditions that existed in the year 1900 in Beaverhead and Madison Counties. Current figures are extrapolated from the DNRC inventory that has stand ate data on 63% of the estimated forest area and represent State land forested area in Beaverhead and Madison Counties.

Cover Type (Stand Age in years)		Non-Stocked & Seedling/Sapling (0-40)	Pole (41-100)	Mature (101-OS*)	Old growth (OS)
Douglas Fir	Historic	33%	28%	13%	26%
	Current	7%	26%	18%	49%
Spruce-Fir	Historic	4%	41%	22%	33%
	Current	2%	40%	18%	40%
Lodgepole	Historic	50%	41%	8%	1%
	Current	22%	39%	15%	24%
Average of Forest	Historic	35%	34%	13%	19%
	Current	11%	31%	17%	41%

*Old stand is defined as 150 years or greater for all stands except lodgepole is considered old growth if greater than 140 years old.

We also attempted to estimate the current extent of high attribute old growth by applying Green et al.'s (1992) characterization of old growth of the U.S. Forest Service's Northern Region. Old growth is typically thought of as forest that is in a state that provides special habitat attributes found at an older age. Therefore it consists of more than just old trees. The problem encountered is that Green et al. did not establish any minimum characteristics other than average age of the largest 4-in size class of trees and density of trees larger than certain diameters

(which were not very large). A few scattered, large, old trees and a few medium-sized trees would qualify a stand for old growth designation under Green et al. Montana Department of Natural Resources (MDNRC) has defined old growth as an older stand (greater than 140 years for lodgepole pine and greater than 150 years for other species) with a minimum 4mbf/acre that exhibit a range of structural attributes, such as large woody debris (LWD), defects and snags that are associated with old age. Determination of high attribute old growth extent was difficult due to the variation and distribution of old trees and structural attributes. There are old trees in almost every unit, and they occur as scattered individuals, scattered clumps, scattered patches that are a couple of acres each, or larger proportions of a stand. Many of the stands are multi-tiered and have many younger trees so that the old trees are a small proportion of the total. Similarly high variation is exhibited by the other habitat attributes.

Fire frequencies before European settlement probably minimized the occurrence of snags and large woody debris (LWD) in the drier forest types, so many old stands in Southwest Montana did not have much of these two components. However, old stands are common in previously unmanaged DNRC forests, and these two components were used in our definition of high attribute old growth to set apart those stands with extra habitat components as candidates for retention and contribution to older-age biodiversity goals. Other old growth stands will be maintained (through active management or preservation) that do not have all of these attributes, but which more closely resemble conditions influenced by frequent fires, so that a variety of conditions are available. The distinction between old growth and high attribute old growth is made to achieve diversity and to ensure that some representation of the range of pre-settlement conditions is available. The following are criteria used to define high attribute old growth and distinguish it from old growth for the Long/Cotton timber sale EIS:

> AGE-- We used the average age of trees larger than 16" dbh in lodgepole pine and 20" in other stands and applied Losensky's minimum stand age as the stand age criterion. These two diameters are based on the bare minimum, and preferred minimum, sizes for pileated woodpeckers, respectively.
>
> VOLUME OF TIMBER PER ACRE-- 4mbf/ac of trees larger than Green's minimum size.
>
> DBH VARIATION-- No requirement.
>
> % DEAD OR BROKEN TOPS-- No requirement.
>
> LARGE WOODY DEBRIS-- Minimum of 3 large logs/acre (from trees 16" dbh in LPP and 20" in other stands).
>
> % DECAY-- No requirement.
>
> NUMBER OF CANOPY LAYERS-- No requirement.

SNAGS-- Minimum of 3/acre that are 8' in height and 16" dbh in LPP and 20" dbh in other stands.

Based on ground reconnaissance, we estimate that there are currently 258 acres of high attribute old growth within the State ownership on the project area (see map). This old growth consists of both East-Side Zone Type 2 and 9 old growth of Green et al. (1992). Data on old growth characteristics and amounts on neighboring ownerships are lacking.

3. Cumulative Impacts

The forested stands in the project area have had relatively little timber harvesting activity in recent decades, although most stands have seen some unregulated logging in the distant past. Of the estimated 2,006 acres of forested lands in the project area, an estimated 78 acres has been harvested in the past 50 years. The BLM has not harvested timber in this area and the area is not part of their timber management base. The DNRC harvested 202 mbf of timber from a partial cut of 45 acres of state land in Price Canyon (T11S, R07W, Sec 3) during 1993. DNRC records relating to the administration of the Montana Hazard Reduction laws were searched to estimate the acreage of private forested land. Those records indicate that a private landowner harvested approximately 33 acres in the south end of the project area in 1987 (Section 3, T11S, R07W). To our knowledge no other timber harvest activity has taken place in the project area during the past 50 years.

FIGURE III-I
PROJECT AREA INDICATING OLD GROWTH STANDS

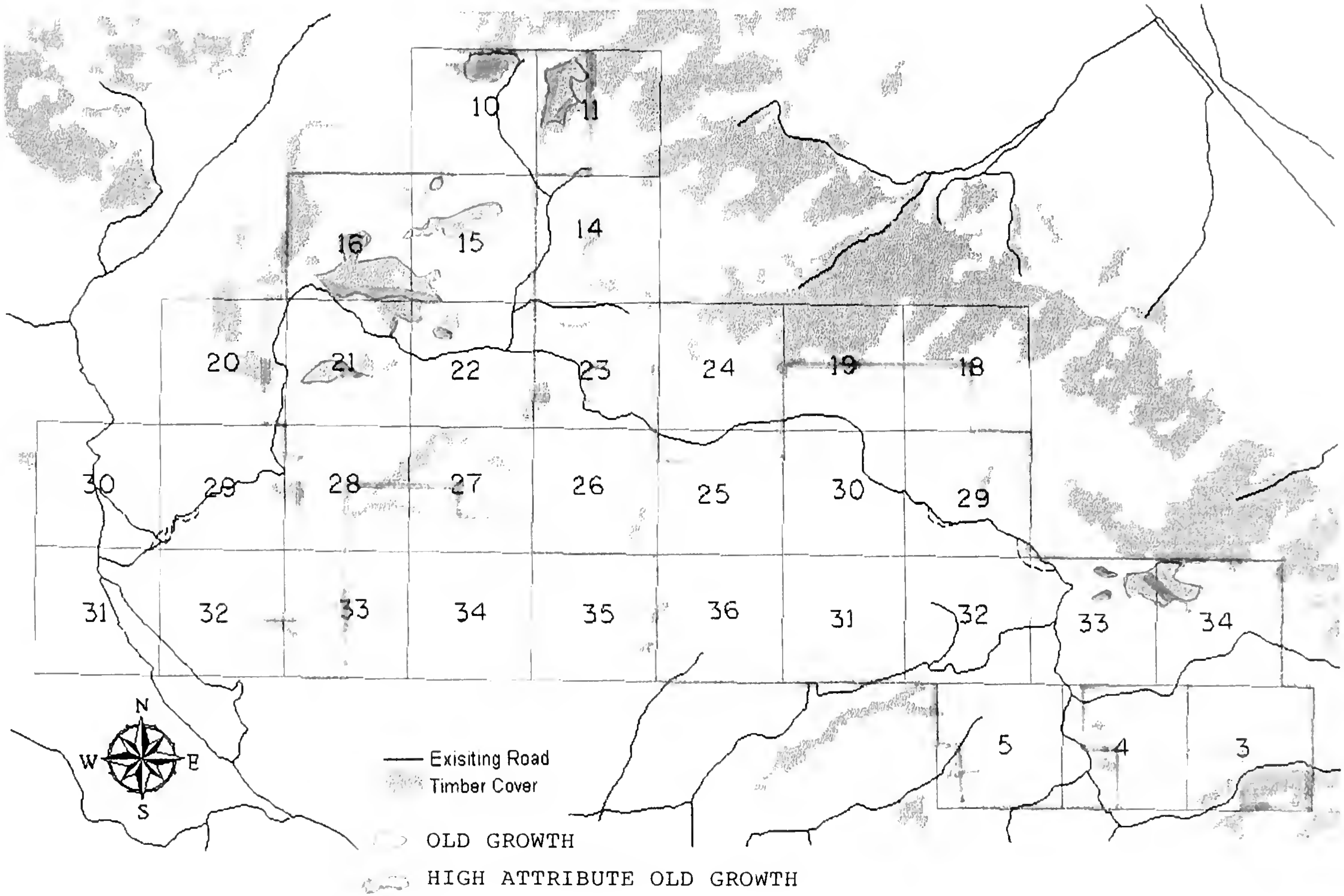
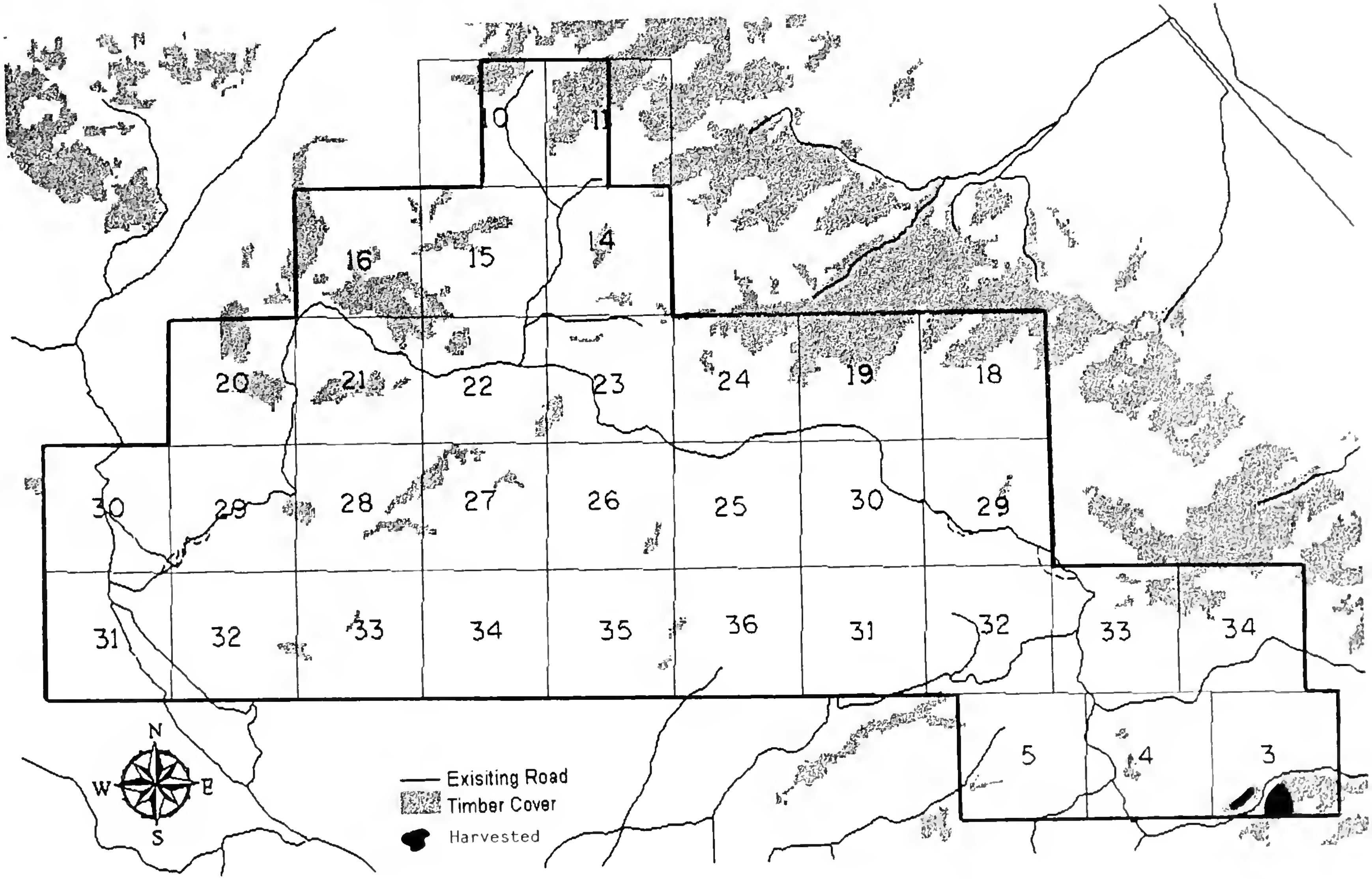


Figure - III-2
PROJECT AREA INDICATING WHERE PAST TIMBER HARVEST OCCURRED



B. INSECT AND DISEASE:

1. Spruce budworm (*Choristoneura occidentalis*)

Spruce budworm activity was noted on state lands during inventory reconnaissance conducted during 1984. The stands do not show much spruce budworm activity at the present time but have all the attributes needed for a spruce budworm outbreak. High stand densities, multi-storied stand structure, and climax host species, along with being in a high frequency area for budworm outbreaks (Silvicultural Strategies to Reduce Stand and Forest Susceptibility to the Western Spruce Budworm, Agricultural Handbook No. 676), all indicate high risk stands for a spruce budworm outbreak.

2. Dwarf Mistletoe (*Acethobium americanum*)

The lodgepole stands in the area are infected with Dwarf Mistletoe. The infestation is generally light and mistletoe caused mortality was not observed.

3. Spruce Beetle (*Dendroctonus rufipennis*)

In the stands containing spruce, Spruce Bark Beetle is present in mostly endemic numbers, with some mortality occurring, primarily in the larger spruce. At the higher elevations found in the project area, the beetle's life cycle normally takes three years to complete.

4. Western Balsam Bark Beetle (*Dryocoetes confusus)*

Western Balsam Bark Beetle is present in the stand in endemic numbers, with a small amount of group mortality occurring in the subalpine fir.

C. Sensitive Plant Species

The Montana Natural Heritage Program (MNHP) was contacted to assess whether sensitive plant species had been recorded from the townships that contain the project area (including a five mile buffer area surrounding these townships) in March, 1996. Six plant species of special concern had been documented for the surrounding area although none had been recorded in the project area itself. The six species were: Carex parryana ssp idahoa, Primula incana, Thelypodium sagittatum ssp sagittatum, Thlaspi parviflorum, Eriogonum caespitosum, and Townsedia florifer. An Internet check of the MNHP data base was made in July 1997. Four species of special concern have been recorded within the two 7.5 minute portions (#84 and #85) of the Lat/Long (#46) containing the project area, although none have been recorded in the project area itself. The four species recorded were Carex parryana ssp idahoa, Primula incana, Thelypodium sagittatum ssp

sagittatum, and Thlaspi parviflorum, all of which had been documented in the 1996 data search.

Carex parryana ssp idahoa This species occurs in moist alkaline meadows, often along streams (Vanderhorst and Lesica, 1994). The only place that habitats of this type occur that would be impacted by the project is at proposed road stream crossings. Pedestrian transects at these sites revealed that the species was not present.

Eriogonum caespitosum This species occurs on dry rolling uplands on Artemesia arbuscula / Festuca idahoensis habitat types (Vanderhorst and Lesica, 1994). This habitat type is not found on sites that would be impacted by the project.

Primula incana This is an obligate wetland species. The only place that habitats of this type occur that would be impacted by the project is at proposed road stream crossings. Pedestrian transects at these sites revealed that the species was not present.

Thelypodium sagittatum ssp sagittatum This species occurs in moist alkaline bottomlands with open exposures (Culver, 1993). The only place that habitats of this type occur that would be impacted by the project is at proposed road stream crossings. Pedestrian transects at these sites revealed that the species was not present.

Thlaspi parviflorum This species occurs on dry rolling uplands (Vanderhorst and Lesica, 1994). The only place that habitats of this type occur that would be impacted by the project is along proposed roads. Pedestrian transects along the proposed road centerlines revealed that the species was not present.

Townsedia florifer This species occurs on dry open areas, often among sagebrush (Hitchcock, 1955). The only place that habitats of this type occur that would be impacted by the project is along proposed roads. Pedestrian transects along the proposed road centerlines revealed that the species was not present.

Plant species noted during pedestrian transects of proposed roads, or during level four general intensity surveys of areas proposed for harvest were compared to the MNHP listing of plant species of special concern (Heidel, 1997). No species of special concern were noted during these surveys.

D. NOXIOUS WEEDS

No noxious weed occurrences were noted within the proposed harvest units or along existing roads.

III. WATERSHEDS AND FISHERIES

A. WATERSHED ANALYSIS AREAS

The proposed timber sale area is located in the Cottonwood Creek, Riley Canyon Creek, and Long Creek watersheds. State parcels in the Long Creek and Riley Canyon watersheds include sections 11,15,16, 21, and 22, Township 10 South, Range 8 West. State sections in the Cottonwood Creek watershed include 33 and 34, Township 10 South, Range 7 West. The proposal also includes use of an existing road system with minor amounts of road relocation and reconstruction in the Divide Creek and Crooked Creek watersheds. All of these drainages are located in the Upper Missouri River Basin. Cottonwood Creek and Riley Canyon Creek are tributaries to Blacktail Deer Creek, which is a fourth-order tributary to the Beaverhead River. Long Creek, Divide Creek, and Crooked Creek are tributaries to Sage Creek, which is a fourth order tributary to the Red Rock River in the Beaverhead River drainage.

The watershed analysis areas were established at a point within each drainage where the potential effects from the proposal are most likely to be detectable. In order to determine this point in the watershed, a combination of professional judgement and qualitative analysis was used (see Figure III-3 - Watershed Analysis Area Map).

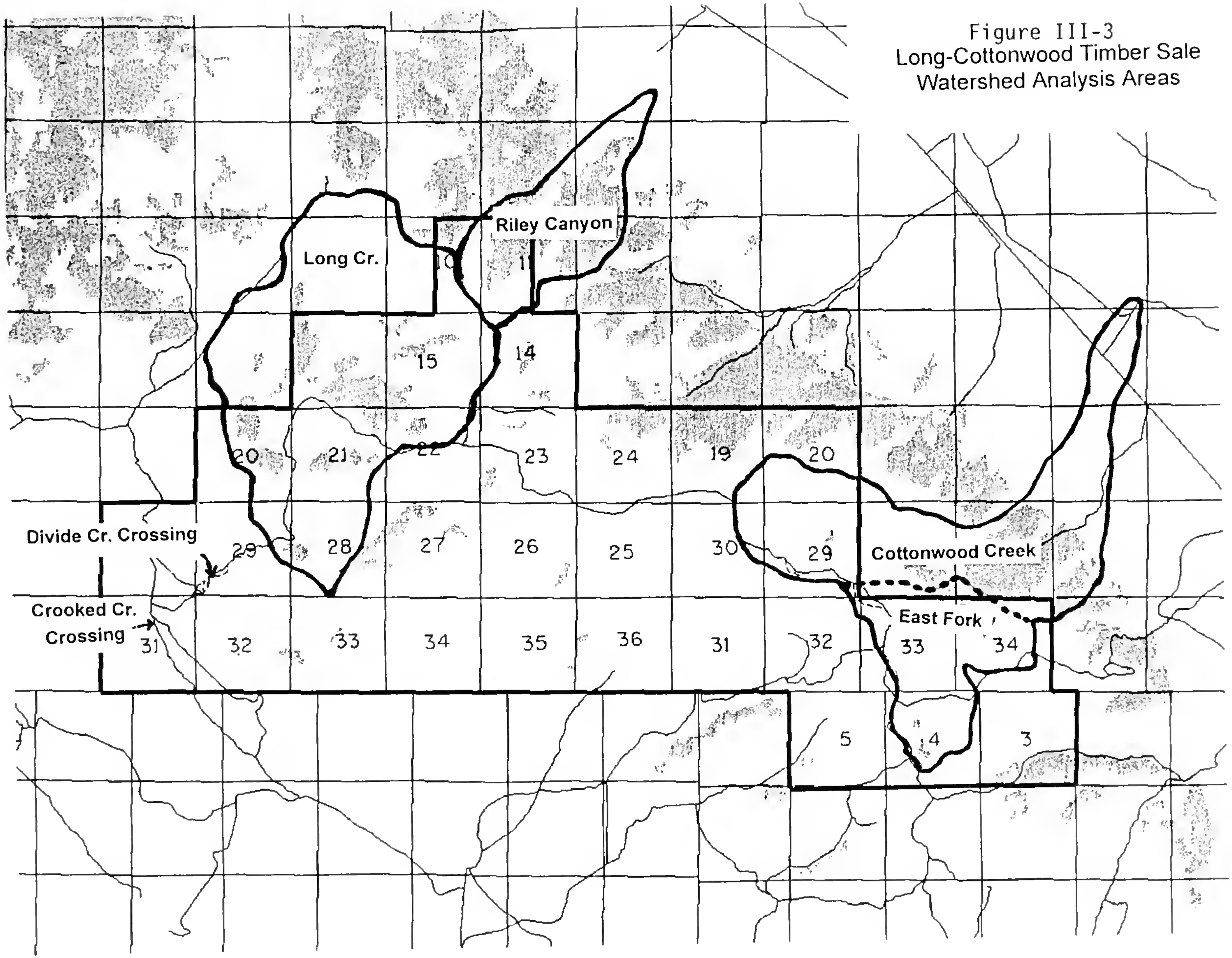
The Cottonwood Creek watershed analysis area incorporates the entire Cottonwood Creek drainage. Due to the fact that harvest activities are restricted to sections 33 and 34, a more detailed analysis was completed for the East Fork portion of the Cottonwood Creek watershed to determine the potential risk of downstream water quality and fisheries impacts to the main stem of Cottonwood Creek.

The Long Creek analysis area incorporates the Long Creek drainage upstream of its confluence with Cattle Creek. This area encompasses approximately 4,818 acres.

The watershed and fisheries analysis completed for Divide Creek and Crooked Creek are confined to those stream reaches where road improvements and relocation of stream crossings are proposed.

The watershed analysis for the Riley Canyon Creek will consist of the immediate sale area and adjacent stream reaches. This is due to low sensitivity and the discontinuous nature of the mainstem stream channel.

Figure III-3
Long-Cottonwood Timber Sale
Watershed Analysis Areas



B. WATER USES AND REGULATORY FRAMEWORK

The Watershed Resource Management Standards contained in the DNRC State Forest Land Mange Plan include the general goal of managing watersheds, soil resources, and streams, lakes, wetlands, and other bodies of water to maintain high quality water that meets or exceeds state water quality standards and to protect beneficial uses.

The watersheds associated with the Long-Cottonwood Timber Sale proposal are classified A-1 waterways in the Montana Water Quality Standards. The water quality criteria for protection of beneficial uses, specific to A-1 waters appear in Section 16.20.618 of the Administrative Rules of Montana (ARM). Uses specific to the proposed activity watersheds include: suitable for drinking, culinary and food processing purposes after conventional treatment for removal of naturally present impurities. Beneficial uses immediately downstream of the proposed activities include cold water fisheries, aquatic life support, irrigation, and livestock watering.

The Clean Water Act (CWA) and the EPA Water Quality Planning Regulations require each state to identify watersheds that contain water quality limited segments (WQLS). A WQLS is a waterbody that is not fully meeting state water quality standards or may have intended beneficial uses (such as cold water fisheries) which are only partially supported or threatened. In 1996, the Montana Department of Environmental Quality (DEQ) published a revised list of WQLS in a document titled the "Montana List of Waterbodies in Need of Total Maximum Daily Load Development". This document is commonly referred to as the 305(b) Report.

Federal laws require that waterbodies identified as water quality limited be targeted for Total Maximum Daily Load (TMDL) development. The TMDL process is used to determine the total allowable amount of pollutants in a waterbody or watershed. Each contributing source is allocated a portion of the allowable limit. These allocations are designed to achieve water quality standards.

None of the streams located within the proposed harvest areas or watershed analysis areas are listed in the 305(b) report. However, both Cottonwood Creek and Riley Canyon Creek are tributaries to Blacktail Deer Creek. Blacktail Deer Creek has been identified as a water quality limited waterbody due to the partially supported status given to the cold water fisheries, aquatic life support, swimmable, and recreation beneficial uses designations and the threatened status assigned to the drinking water supply uses. The probable causes of impairment are listed as "flow alteration, nonpriority organics, siltation and other habitat alterations". The probable sources of impairment are listed as "agriculture, animal operations, flow regulation-modification, natural sources, nonirrigated crop production, rangeland, removal of riparian vegetation, streambank modification and destabilization". Silviculture and road construction was not identified as probable sources.

The Montana TMDL Law (75-5-702 and 703 MCA) directs the Department of Environmental Quality to assess the quality of state waters and to develop TMDL for those waters identified as threatened or impaired. Under the Montana TMDL Law, new or expanded nonpoint source activities affecting a listed water body may commence and continue provided they are conducted in accordance with all reasonable land, soil and

water conservation practices. Total Maximum Daily Loads have not been completed for the Blacktail Deer Creek drainages. DNRC will comply with the Law through implementation of all reasonable soils and water conservation practices; including Best Management Practices and Resource Management Standards as directed under the State Forest Land Management Plan.

Additional laws applicable to the Long-Cottonwood Timber Sale proposal include the Montana Streamside Management Zone Law (77-5-302 MCA) and the Montana Stream Protection Act (87-05-501 MCA).

C. WATERSHED CONDITION MEASUREMENT INDICATORS

The following methods were used to assess and describe the existing conditions of the water resources within the affected environment:

1) Stream Channel Inventory and Evaluation: Stream channels within the affected watersheds were inventoried and have been delineated into individual stream "reaches". A stream reach can be described as a segment of a stream channel that displays similar geomorphic attributes and responds similarly to changes in water yield, sediment supply, and inputs of large woody debris. The tools used to inventory, evaluate and describe each reach are the Rosgen Stream Classification System (Rosgen, 1996) and the U.S. Forest Service Region 1 Stream Reach Inventory and Channel Stability Rating Evaluation (Pfankuch, 1975) or reconnaissance level stream surveys. These tools were deemed the most appropriate to provide information on stream channel form, function, and resistance to change. These evaluation also provide information necessary to evaluate the potential response of stream channels to differing levels of inputs such as large woody debris, sediment, and water yield.

The Rosgen classification system involves classifying stream reaches into channel types based on measured geomorphic characteristics including, entrenchment ratio, water surface slope, surface particle size distribution, sinuosity, and width/depth ratio. These measurements are calibrated to the bankfull dimension of the channel, as the bankfull flow is considered the channel maintenance, or effective discharge. When described in a watershed context, the Rosgen system provides insight into the processes governing sediment transport and physical channel processes active throughout the watershed.

The Pfankuch Methodology uses 14 parameters, directly related to channel stability, to evaluate the conditions of the upper stream banks, the lower stream banks and the channel bottom. These parameters are empirically weighted and summed to yield an overall channel stability rating for each reach. This rating is used to evaluate the resistive capacity of a stream channel to the detachment of bed and bank material and to provide information about the capacity of the stream to adjust and recover from potential changes in flow and /or increases in sediment production.

2) Physical Habitat Assessment: The procedure to evaluate instream habitat is an ocular procedure developed by Barbour and Stribling (1991). It includes evaluation of various habitat components, including: bottom substrate; habitat complexity; pool quality; bank stability; bank protection; and riparian canopy.

3) Water Yield: The equivalent clearcut area (ECA) method was used to determine the potential for increased water yields due to forest crown removal and road construction. Forest cover and existing harvest levels were determined using LANDSAT satellite imagery (1996), aerial photographs (1978), BLM harvest records, and DNRC hazard reduction records, and field reconnaissance of the project area..

D. WATERSHEDS DESCRIPTIONS - EXISTING CONDITIONS

Cottonwood Creek

The Cottonwood Creek watershed encompasses 4,325 acres and is drained by a perennial, Class I tributary to Blacktail Deer Creek (see Figure III-3 Watershed Analysis Areas). Elevations in the Cottonwood Creek watershed range from 6,078' at the confluence with Blacktail Deer Creek, to 8,800' at the headwater divide. On average, the watershed receives 15"-20" of annual precipitation in the form of rain and snow. The main source of streamflow in the Cottonwood Creek drainage is from the melting of the winter snowpack and several perennial contact springs located in the headwaters of the drainage. In general, peak discharges occur during the months of April, May, and June. During the summer and fall months, base flows are maintained through groundwater exchange and seasonal rains. The Cottonwood Creek watershed most likely experiences very "flashy" runoff that can vary tremendously between low and high flows within a very short time period. This premise is supported by channel conditions as described in the following section.

Water Yield

Past timber harvests I Cottonwood Creek are limited to moderate levels of selection and post and pole cutting that occurred in the 1930's. These area harvests have regenerated and are considered hydrologically recovered. Douglas-fir habitat types dominate the forested portions of the Cottonwood Creek drainage. Stands of aspen and cottonwood occur in the lower reaches of the drainage. A majority of the watershed area is non-forested and consists of open rangeland; however, encroachment of Douglas fir has occurred due to fire suppression. The presence of mollic soils (high organic range soils) supports this observation. Estimate of % forest cover, existing harvest levels, and ECA are displayed in Table III-3.

Table III- 3: Estimates of Forest Cover and Equivalent Clearcut Area - Cottonwood Creek

Watershed Acres	% Forest Crown and Forested Acres	% Forested Area Harvested	Equivalent Clearcut Acres (ECA)	% of Watershed Area In ECA
4,325	30%, 1,297 acres	1%	Negligible	1%

The potential for management induced water yield increases in Cottonwood Creek are low due to the partially forested natural condition of the watershed, lack of existing harvest and ECA, and the relatively low levels of annual precipitation occurring in the drainage.

Stream Channel Inventory

Reach One

The lower reaches of Cottonwood Creek are formed on broad alluvial outwash fans with slopes ranging between 2-4% (see Figure III-2 Watershed Map). Alluvial fan landforms are characteristic of a high sediment supply originating from steep, entrenched, erosional drainages. Reach one is characteristic of a Rosgen D-4 channel type. Channels of this nature have naturally high bank erosion rates, lack bank stabilizing vegetation, and typically are highly unstable. Reach one was a multiple threaded, braided channel. Channel materials were comprised of sands and medium cobbles, with a majority of the banks exposed and actively eroding. In general, due to the high sediment supply and lower gradient, the reach is considered transport limited. In other words, sediment supply exceeds the transport capability of the reach, which in turn leads to deposition and aggradation. The undersized culvert on the county road that prevents bedload transport during effective discharges may exacerbate this process.

Table III-4: Channel Characteristics - Reach One Cottonwood Creek.

Elevation Range	Channel Type*	Channel Stability Rating**	Habitat Assessment
6.130' - 6,240' upstream of county road	D-4	148 - Poor	N/A

* Rosgen 1996
** Pfankuch, 1975

Several watershed conditions are responsible for channel braiding, including high sediment supply, high bank erodibility, and very flashy runoff conditions. Cattle use within reach one is also very high, and is contributing to bank instability.

Channel reaches can be classified as "losing" or "gaining" based on their interaction with subsurface groundwater. During the summer months, baseflows are maintained by groundwater discharge to the channel. However, if the opposite occurs (surface loss to the groundwater), the reach is considered a hydrologically "losing" reach. Reach one is considered a losing reach and is normally dry during the summer months. This isolates the upper reaches of the watershed from Blacktail Deer Creek during most of the year with the exception of high runoff events. This process appears to act as a fisheries migration barrier during dry months; and may account for the 98% genetically pure population of westslope cutthroat (see Fisheries section). A physical habitat assessment was not completed on this reach due to these reasons.

Reach Two

Upstream of Reach One, the riparian community and landforms are more influential on channel processes and stability, resulting in a change in channel type. A dense stand of aspen and cottonwood occurs through Reach Two, most likely due to a rise in the local water table elevation. This portion of Cottonwood Creek dissects deep alluvial fan deposits and debris slides originating from upper Cottonwood Creek and adjacent side slopes. Although this reach is more resistant to scour and erosion than Reach One, there

is evidence that channel adjustment is occurring. Channel banks are exposed in most locations and actively contributing sediment during high flow events. Bank composition is predominantly large cobbles and gravels, indicating that the channel has experienced periods of both downcutting and filling. At present, the reach is in the process of downcutting, evolving from a moderately entrenched Rosgen F-4 stream type to an entrenched Rosgen G-4 "gully" type in locations. A terrace is also present through the reach indicating that the channel has down cut extensively through slide debris and alluvial fan deposits in the recent past. A terrace is an old floodplain that has been abandoned by the stream due to fluvial processes such as downcutting. Although some braiding is occurring through the reach, the presence of intact riparian vegetation appears to be controlling excessive rates of lateral migration.

Table III-5: Channel Characteristics - Reach Two Cottonwood Creek

Elevation Range	Channel Type*	Channel Stability Rating**	Habitat Assessment
6,220' - 6,440'	F-4 / G-4	97 - Good	Marginal

* Rosgen 1996
** Pfankuch, 1975

The mean particle size diameter through Reach Two was classified as cobble. However, a substantial accumulation of fine sediment has been deposited on channel bottom. Although there is some structural complexity through the reach (woody debris, pools, undercut banks), the quality of available instream habitat is marginal due to localized areas of instability and naturally high sediment supply.

Cattle use through Reach Two is moderate; however, the inherent instability of the reach is most likely attributed to natural processes and the sensitivity of the landform in which the reach is formed.

Reach Three

Reach Three includes the main stem of Cottonwood Creek upstream through the canyon to the confluence with the East Fork (see Watershed Map). This portion of Cottonwood Creek is a structurally controlled drainage feature developed in a deeply incised fault zone. The valley landforms are steep, glacial scoured slopes highly dissected by Cottonwood Creek. Valley materials are comprised of bedrock, colluvium and landslide debris consisting predominantly of metamorphic gneiss.

Table III-6: Channel Characteristics - Reach Three Cottonwood Creek

Elevation Range	Channel Type*	Channel Stability Rating**	Fisheries Habitat Assessment
6,400 - 7,380	B-2 A-2 inclusions	85 - Fair	Suboptimal

* Rosgen 1996
** Pfankuch, 1975

Reach Three is prone to high levels of sediment production due to steep valley sideslopes and talus slopes (50-60%). In addition, portions of the channel were placer mined in the past. Several abandoned stream crossings are currently contributing to instream sedimentation during high flows as the channel banks in these isolated areas are more susceptible to erosion. The main channel is dominated by boulders and large cobbles and has a step-pool bedform morphology controlled by large boulders and coarse woody debris.

Large Woody Debris

Although Large woody debris (LWD) is present throughout most of the forest reaches in Cottonwood Creek, a departure from historic levels has most likely led to some channel alterations, including: decreased frequency of pools; riffle extension; and increased stream power that translates to higher rates of bank erosion. Numerous studies have compared levels of instream LWD to fish density, available habitat and species age class distribution. Assuming a decline in natural levels of LWD due to riparian harvest and placer mining, current populations of native fish species have most likely declined from historical conditions.

Roads

There are no definable, open roads upstream of the county road crossing. An old, abandoned two-track road occurs along a bench that parallels the main stem of Cottonwood Creek; however no direct impacts to water quality are occurring. There are several old existing crossing sites within the riparian corridor along the main stem (concentrated in Reach 3). These sites, although reflecting signs of instability, are no longer accessible to motorized vehicles. The existing road and crossings are used for hunter access only.

East Fork Cottonwood Creek Watershed

The East Fork is a second order perennial Class I tributary to Cottonwood Creek which drains a watershed area of approximately 1,326 acres. This analysis area encompasses the immediate area in which DNRC activities are proposed for Sections 33 and 34.

Water Yield

A majority of the analysis area is non-forested and consists of range cover types. Past timber harvest in the East Fork are limited to historic selection and post and pole harvest that occurred in the 1930's. These harvest areas have largely regenerated and are considered hydrologically recovered. Estimates of % forested and harvest levels in the basin were calculated (see Table III-7).

Table III -7: Estimate of Forest Cover and Equivalent Clearcut Area - East Fk. Cottonwood Cr.

Watershed Acres	% Forest Crown and Forested Acres	% Forested Area Harvested	Equivalent Clearcut Acres (ECA)	% of Watershed Area in ECA
1,326	20%, 226 acres	1%	Negligible	1%

The potential for management induced water yield increases in the East Fork of Cottonwood Creek are also low. As discussed under Cottonwood Creek this is due to the partially forested natural condition of the watershed, low levels of existing harvest and ECA, and the relatively low levels of annual precipitation occurring in the drainage.

Stream Channel Inventory

Reach Four

Reach Four, as delineated on the Watershed Map, is a perennial Class I tributary to Cottonwood Creek and includes two tributaries originating in Section 34. These tributaries are also Class I stream segments. A 1/4 acre spring in Section 34 feeds the western tributary to Reach 4, and is considered an adjacent wetland according to wetland RMS #12.

The channel through Reach Four is fairly entrenched and downcut through historic slide debris. It is naturally unstable due to the unconsolidated material in which it is formed and the high sediment supply from both upslope and channel derived sources. Past and current activities such as placer mining and riparian grazing have exacerbated these effects.

Reaches Five-Eight

Reaches five through eight are located upstream of the proposed activities. The upper headwater channels of East Fork of Cottonwood Creek are deeply incised in depositional material derived from hillslope wasting, glacial till, landslide debris, alluvial fan deposits and in-channel sources. Sideslopes in most area exceed 40%, and are highly erosive. Soils are a heterogeneous mixture of unconsolidated non-cohesive material in colluvium, and are highly susceptible to mass wasting and failure. Bank erosion and bedload transport rates are generally very high in this type of system due to low width/depth ratios, moderate channel gradients, and high sediment supply from hillslopes (G-3 stream type).

Reaches five through eight are spring-fed, perennial Class I streams. Several discontinuous and continuous gullies occur at the head end of these channels, and contribute direct sediment to downstream Class I reaches during large storm events. A "discontinuous gully" is characterized by a prominent headuct located at any position on the slope of a hillside, while a "continuous gully" always starts high upon the mountainside and continues its course down to the main valley floor (Heede, 1975). A majority of the area has been heavily impacted by cattle use; activity that has either caused or

exacerbated gully formation by depleting vegetative cover. During field review, a large rainstorm initiated surface flow through these gully systems, increasing suspended solid and turbidity levels by several orders of magnitude. These gullies are considered a direct source of sediment to the East Fork and the mainstem of Cottonwood Creek during precipitation events.

Roads

Approximately 2.7 miles of low-standard two-track road exist the East Fork analysis area. The road traverses the upper reaches of Cottonwood Creek and crosses four ephemeral draws and swale features that contribute surface runoff during precipitation events.

The ephemeral draw and swale crossings (4) within the East Fork analysis area were reviewed for their sediment delivery potential. In general, they pose a low risk to tributaries and the main stem of Cottonwood Creek. All of the existing crossings occur in ephemeral draws and swales. Although they contribute water and sediment to tributaries to Cottonwood Creek, delivery potential is low due to the hydrologic nature of the draws and swales. When compared to sediment levels being delivered to the system from the headwater gullies, contribution from these crossings is considered negligible.

LONG CREEK Watershed

The Long Creek watershed analysis area encompasses approximately 4,818 acres of the headwaters portion of the Long Creek drainage. This area is drained by a third order, perennial, Class I stream (see Figure III-2 Watershed Map). Elevations in the Long Creek drainage range from 7,200' at the confluence with Cattle Creek, to 9,500' at the headwater divide. On average, the watershed receives 15-20" of annual precipitation in the forms of rain and snow. The main source of streamflow in the Long Creek drainage is from the melting of the winter snowpack and several perennial contact springs located in the headwaters of the drainage. In general, peak discharges occur during the months of April, May, and June. During the summer and fall months, base flows are maintained through groundwater exchange and seasonal rains.

Water Yield

Douglas-fir habitat types dominate forested portions of the Long Creek watershed. A majority of the watershed area is non-forested and consists of open rangeland. Past timber harvest in Long Creek are limited to historic post and pole cutting that occurred in the 1930's and 2 acres of post and pole harvest that occurred on state land in Section 16 in 198?. The historic harvest have regenerated and are considered hydrologically recovered. Estimates of % forested and existing equivalent clearcut acres in the basin are displayed in Table 111-8::

Table III-8: Estimates of Forest Cover and Equivalent Clearcut Area

Watershed Acres	% Forest Crown and Forested Acres	% Forested Area Harvested	Equivalent Clearcut Acres (ECA)	% of Watershed Area In ECA
4,791	35%, 1,686 acres	1%	2	1%

The potential for appreciable water yield increases is low in Long Creek. This conclusion is based on values presented in Table III-8 and the low levels of average annual precipitation occurring in the drainage.

Stream Channel Inventory

The lower reaches within the Long Creek analysis area (Sections 20,28,29) are formed in unconsolidated alluvial and colluvial valley materials. The main channel is susceptible to shifts in both lateral and vertical stability due to the nature of the valley fill and livestock grazing that has displaced a majority of the riparian vegetative component through the reach. Portions of the reach have undergone some degree of transition from their stable state, and are fairly impacted. The most obvious changes include: channel incision and downcutting, increased channel width, and increased rates of lateral erosion. The current stream is responding to these changes through a series of channel adjustments.

Upstream through Section 16, Long Creek is formed in coarse depositional material derived from colluvial deposits and alluvium (Class I stream). The channel bed morphology is dominated by cobble materials and characterized by a series of riffles and scour pools. In some areas, the channel has downcut through slide debris derived from hillslope processes. The channel becomes more entrenched and incised in these areas. Cattle impacts are evident through Sections 15 and 16, but due to the more resistant materials and presence of forested riparian cover, they are not as extensive as documented through Sections 20, 28, and 29. An adjacent wetland occurs in the southwest corner of Section 16.

Roads

The existing transportation system in the Long Creek watershed consists of 4.4 miles of low standard two track roads. The road crosses Long Creek, a Class I perennial stream on private land between Sections 28 and 29. The existing crossing is a drive-through ford and poses a direct risk to water quality as approach grades exceed 15% and lack drainage features. Sediment is routed directly to the creek during storm events. In addition, instream sediment is generated during use due to the lack of armoring provided by the fine grained composition of bank and channel bottom materials.

The road continues north through Section 20 and is located adjacent to Long Creek within the SMZ. Concentrated use within this area (vehicle traffic and cattle use) has led to bank destabilization and channel degradation. Sediment delivery to Long Creek is occurring throughout this reach.

DIVIDE CREEK

Divide Creek is a 3rd order perennial tributary to Long Creek. The only activities planned under the DNRC proposal in the in the Divide Creek watershed is the use of an existing road system. Therefore, the watershed analysis for Divide Creek was limited to an evaluation of the existing road and stream crossing. The existing road system is low standard, poorly maintained and does not meet BMPs. The main access road includes a drive through ford crossing of Divide Creek (Section 29, private ranch land). The approach grades to the crossing site are steep (6-19%) and lack adequate surface drainage relief. The road surface is not maintained and can become severely rutted. This location is a direct source of sediment to Divide Creek during runoff events. Due to the perennial nature of this reach, the ford crossing of Divide Creek most likely generates instream sediment sources that may potentially impact downstream beneficial uses such as cold water fisheries.

RILEY CANYON CREEK

Riley Canyon Creek is a small intermittent tributary to Blacktail Deer Creek. The mainstem is discontinuous and does not have direct channel delivery to Blacktail Deer Creek. The proposed harvest unit in Section 11, T 10S R8W is located adjacent to a perennial Class II segment of the mainstem channel in the extreme headwaters of the drainage. The channel is moderately entrenched and has been impacted by cattle activity within the SMZ. The proposed harvest unit (#7) contains a Class III, ephemeral tributary to Riley Creek.

E. FISHERIES

The Montana Department of Fish, Wildlife, and Parks completed fish population surveys in Cottonwood Creek, Long Creek, Divide Creek, and Riley Canyon Creek in 1993 and 1994. These surveys were conducted to determine the presence or absence of westslope cutthroat trout and to determine the genetic status of any westslope cutthroat found.

Surveys conducted in Cottonwood Creek found a near pure population of westslope cutthroat trout (98% genetically pure) which was slightly introgressed with Yellowstone cutthroat. Mottled sculpin were also present in these surveys. The surveyed reach is located near Stream Channel Inventory Reach 3, which is approximately 2 miles downstream of the proposed sale area in Cottonwood Creek. Fisheries biologists from the DFWP believe that it is likely that the headwaters of Cottonwood Creek also contain individuals or populations of pure westslope cutthroat trout (Oswald 1997).

Surveys were completed for Divide Creek both upstream of and in the immediate vicinity of an existing road and ford crossing. This road and crossing are included as one of the proposed timber sale access and haul routes. The upstream surveys found westslope cutthroat trout (88% genetically pure) which are heavily introgressed with both rainbow trout and Yellowstone cutthroat trout. Mottled sculpin and a few brook trout were also collected at the upstream site. Sampling in the vicinity of the access road and ford crossing contained only eastern brook trout and mottled sculpin.

Long Creek was sampled in Section 33 T10S, R7W, several miles downstream of the proposed harvest areas, existing access road and ford crossing. These samples also only contained eastern brook trout and mottled sculpin. However, according to a fisheries biologist from DFWP, "this does not preclude the possibility of the existence of a pure westslope cutthroat population in the headwaters or in the vicinity of the proposed road" (Oswald 1997). No additional data is available at this time, therefore, DNRC assumes that westslope cutthroat trout are present in Long Creek and will design all activities proposed in this drainage with appropriate mitigation.

Two fisheries surveys were completed on a 1000' and a 2000' perennial reach of Riley Canyon Creek downstream of the proposed harvest area. No fish were captured or observed in either of these surveys.

IV. SOILS AND GEOLOGY

A. Long Creek/Riley Canyon

The project area is located on the upper slopes of the Blacktail Mountains and is accessed from the south via the Sage Creek road. Bedrock types are varied and soil properties are strongly influenced by parent material type due to the young stage of soil development. The Sage Creek access road crosses open rangelands with varied soil materials of clay rich valley floor deposits and cobbly alluvium from mixed bedrock types. As part of the Blacktail Mountains, the western ridge forming the Long Creek drainage is bounded by limestone uplifted along a fault (Pecora, 1987).

Limestone bedrock underlies the forest sites in section 16,20 & 21 and forms moderate to deep cobbly loams. Soil depth is shallower on steep mountain side slopes over 40% and ridges in unit 10 & 11 and supports Douglas fir, subalpine fir and some lodgepole on northerly aspects. These high rock fragment soils are low productivity sites due to climate, low moisture availability, and carbonate subsoils. Slope steepness on a portion of the area limits equipment use to cable operations due to erosion and displacement hazard.

The mid and lower slopes of 20-45% (units 1,2,& 3) have deeper more productive glacial till soils derived from limestone. Moderate to deep cobbly loams and cobbly silt loams have higher moisture and nutrient retention, supporting Douglas fir, subalpine fir and some spruce. These sites and slope range are well suited to conventional tractor skidding when relatively dry. Erosion hazard is moderate and can be mitigated by skid trail planning and season of use limitations.

Progressing east along the broad Blacktail Ridge there is a band of quartzite running north/south near the line between sections 15 and 16, which underlies the east half of proposed harvest units 2 and 3. The ridge and convex slope have very shallow topsoils over fractured bedrock. Mid to lower slopes are coarse textured, extremely gravelly and cobbly sandy loam soils with more depth and slightly better productivity that support lodgepole pine. Climate, moisture and nutrient availability limits plant growth. Slope steepness and erosion hazard limit equipment use. This limitation can be overcome by cable or helicopter harvest methods.

B. Cottonwood Creek

The rounded convex ridges and steeper slopes have shallow to moderate depth soils developing from metamorphic gneiss bedrock. South and westerly aspects are typically sagebrush and grasslands with dark surface soils of gravelly silt loam over cobbly sandy loams. Erosion is moderate on slopes less than 30% and risk increases to high on steeper slopes. Bedrock outcrops occur on steeper slopes and ridges and will likely require blasting for segments of road construction to access proposed Unit 8.

Primary soils within the forested sites of the proposed harvest unit 8 are deeper cobbly sandy loam soils and cobbly sandy clay loam soils developing in a mix of alpine till deposits and fractured gneiss bedrock on mountain side slopes of 35-70%. Steep slope and shallow rock limit equipment use to cable or helicopter methods. These soils are droughty and subject to erosion where disturbed. Vegetation can be slow to establish and requires above average efforts to stabilize soils and provide erosion control. Leaving slash can provide shade to enhance survival of seedlings. Soils dry out rapidly after snowmelt in most proposed harvest units and allow adequate season of use from about July through fall.

C. Geology/Stability

There are mineral deposits in the Cottonwood Creek drainage area but otherwise no especially unusual or unique geologic features were identified in the proposed harvest area. Slopes within the project area are generally stable due to the extensive area of shallow bedrock and only localized signs of marginal slope stability were observed within the project area. Portions of the stream banks of Cottonwood Creek were placer mined which led to head cutting and erosion of oversteepened cutbanks. In section 10, a small glacial cirque is formed on shales that include localized areas of marginal slope stability. This moist site supports a mixed stand of fir and spruce in Unit # 6.

V. WILDLIFE:

We employ the concepts of "coarse" and "fine filters" as useful metaphors for looking at the effects of human activities on wildlife. Briefly, the coarse filter asks if the suite of habitat elements that supports all the constituent species is compromised, and/or if habitat and landscape characteristics are altered beyond the range of naturally occurring variation. The fine filter views specific habitat requirements of individual species. We first apply the coarse filter because species and their individual habitat requirements are too numerous to consider all of them simultaneously. However, because some species are under particular threat due to past habitat loss, or are of particular interest, we also apply a fine filter for selected species that may have "fallen through" the coarse one. In this latter category are threatened and endangered species, sensitive species, and big game species.

Cumulative impacts were considered as part of the analysis. Two nested landscape analysis areas have been delineated for the Long/Cotton Timber Sale based on the area utilized by the predominant elk herd and land ownership. The Large Analysis Area (Figure III-4) encompasses 87,945ac and is defined by the polygon connecting the outermost yearlong distribution of radio-telemetry locations from the Blacktail Ridge herd [map of polygon from Ken Hamlin, Montana Department of Fish Wildlife & Parks (MDFWP)]. The small analysis area is the Project Area

(Figure III-4) and consists of the block of state ownership in the vicinity of the proposed timber sale and intermingled ownership, for a total of 20,371ac within this smaller polygon. The existing landscape is considered to be a reflection of past management activities, so analyses of existing conditions include the effects of those activities. Classification of forest/nonforest in a geographical information system (GIS) based on 1996 Landsat imagery suggests little, if any, timber harvest in the Large Analysis Area. This is further substantiated by the classification of most of the BLM land as Roadless or Wilderness Study Area."

A. Coarse Filter: Habitat Elements Supporting Biological Diversity

1. Landscape Characteristics

The Project Area (Figure III-4) lies in the Blacktail Mountains southeast of Dillon, Montana. These mountains are generally forested on the northerly slopes, with timber becoming patchier in the upper reaches of the northerly draws. The draws that drain in a southerly direction have patches of timber in their upper reaches and some areas of scattered trees. The rounded ridgetop and most of the area surrounding those timbered north slopes are predominated by grassland landforms so that many of the forest stands of the Blacktails form islands of cover for those species that depend on forest cover.

Forest habitat fragmentation is a landscape issue that has received a great deal of attention in recent years primarily due to the decline of Neotropical migrant songbirds in the eastern United States. Attention has also grown due to an increased focus on amphibians (which may have high sensitivity to drier conditions that occur after loss of forest cover and poor mobility that limits their ability to move to better habitat). A third reason for increased attention to fragmentation is the discovery of "area sensitivity" of some birds. Area sensitivity is the apparent requirement by some species for a large amount of contiguous habitat. Studies in the western United States have contrasted to date with the eastern studies in that vertebrate richness and abundance in the West have been found to be only weakly tied to stand size and isolation except for just a few species (Lehmkuhl et al. 1989, Raphael 1984, and Rosenberg and Raphael 1986). Some birds that appear to be forest interior species are the winter wren (*Troglodytes troglodytes*), Swainson's thrush (*Catharus ustulatus*), and varied thrush (*Ixoreus naevius*) [(A. Hansen and J. Peterson, pers. comm., cited by Lehmkuhl and Ruggiero (1989)]. It certainly makes intuitive sense, too, that several species of amphibians and small mammals would suffer habitat degradation from edge effects, but the effects remain to be substantiated by research (Lehmkuhl and Ruggiero 1989). Conversely, those species associated with forest edges benefit from fragmentation, but since edge-associated species are common, their welfare has not often been an issue except in the case of some game species.

Landscape indices were calculated on the existing condition in a rather coarse manner because there is no existing stand-level inventory available for GIS (geographical information systems) analysis of patch characteristics. GIS

database information is only available for this area for forest versus nonforest from satellite imagery. Landscape indices for the current condition at both analysis scales are listed in Table III-9. As determined from satellite imagery, forest covers approximately 25.0% of the Large Analysis Area and 9.8% of the Small Analysis Area. The largest forested patch in-the Large Analysis Area is 9,098 ac and lies in the western half of this area in the Sheep Creek drainage. Within the Long/Cotton Project Area, 47 forested patches vary in size from .2 to 336 acres, with an average within the Project Area of 39.6 acres. The largest contiguous forested patch within the Project Area is on the south side of Jake Canyon, Section 24-T10S-R8W and Section 19-T10S-R7W; the second largest, about 226 acres, is situated in Sections 15, 16, 21, and 22-T10S-R8W (Sale Units 2 and 3).

Most of the timber stands within the Project Area have been selectively logged in the distant past by trespass loggers. Most of this logging was very light, with a few small areas where up to an estimated 3 MBF / ac was removed.

Figure - III-4
LARGE ANALYSIS AND PROJECT AREA MAP INDICATING NONFORESTED AND FORESTED COVER

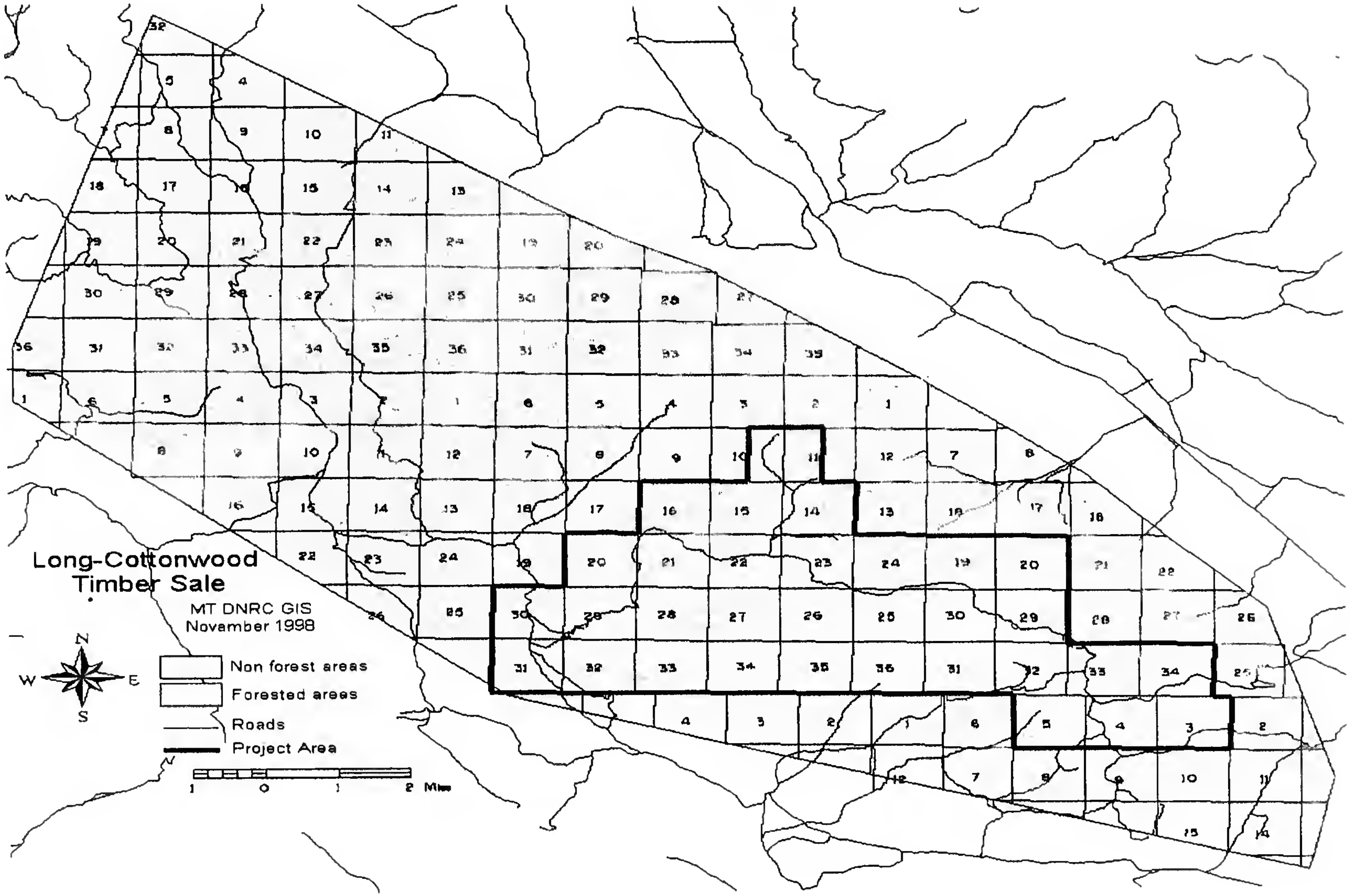


TABLE III-9. Landscape indices for existing conditions in the vicinity of the Project Area.

INDEX[1]	PROJECT (SMALL) ANALYSIS AREA	LARGE ANALYSIS AREA
Analysis Area (ac)	20,371	87,945
Proportion Forested	9.1%	25.0%
Number of Forested Patches	47	123
Average Forest Patch Size (ac)	39.6	178.8
Forested Patch Shape Index[2]	1.63	1.92
Double Log Fractal Dimension[3]	1.23	1.43
Forest/Grassland Edge Density (ft/ac)	15.8	28.9
Percent of Forest in "Core" Patches[4]	32.96	54.46
Density of Forested "Core" Areas[5]	.36	.46
Mean Distance to Nearest Other Forested Patch (ft)	983.3	588.3

[1] See McGarigal and Marks (1994)
[2] An index of the complexity of shape, relative to a square. For squares, which have the least possible perimeter/area for any polygon, this index is 1.0. Polygons with more complex shapes (i.e., more convoluted or dissected than a square) have higher index values. This index has no upper limit.
[3] A similar index to the above, but the units here are the "dimensionality" of the polygon. As complexity increases from simple to complex, this index increases from 1.0 towards 2.0.
[4] "Core" was defined in this analysis as portions of each patch >100m from the patch edge. This is an index to the total core area.
[5] Expressed in number of "core" forested areas per 100ha (roughly 247 acres).

Marcot et al. (1994), in a landscape-level analysis, drew a useful distinction between two groups of animals based on the way they utilize the landscape. He called these two groups "multitype" and "unitype" species. Among the former, elk is chosen as a good example; because elk divide their time between open and forested patches, proximity to edge is advantageous. Among the unitype species, some species can further be categorized as "forest interior" species, i.e., species for which edge is unfavorable. Observation of the current pattern of forests and grasslands suggests that the natural condition of the Project Area is one of relatively small forest patches, close interspersion of forests and grasslands, and high density of edges, favoring multitype species. Forest interior conditions are uncommon within the Project Area due to the naturally small forest patch size. In summary, the forest in its natural condition is highly fragmented, with many small patches poorly connected, especially in the Project Area.

2. Forest Types, Successional Stages, and Fire History:

a. Forest Types

The Blacktail Mountains area falls under Losensky's (1997) climatic section 13 (Section M332E), which encompasses the southwest corner of Montana and the upper Salmon and Lemhi drainages in Idaho, and includes Beaverhead County. In this climatic section, forested cover types were historically (1930's) found on about 39% of the area, with the remainder being grassland and shrubland.

b. Successional Stages

It is helpful to put the current proportions of successional stages into historical perspective because of wildlife habitat implications. Table III-2 compares Losensky's estimates of the average historical condition with our estimates of the current condition.

It is prudent to maintain a variety of forest age classes and at least some large stands of similar habitat attributes to meet biodiversity goals because each age class is attractive to a subset of species and some species are area-sensitive. The State Forest Land Management Plan (SFLMP) (MDNRC 1996) sets the management goal of managing for a desired future condition characterized by the proportion and distribution of forest types and structures historically present on the landscape. DNRC would seek to maintain or restore old growth forest in amounts of at least half the average proportion that would be expected to occur with natural processes on similar sites. Old growth is of particular concern in the managed landscape because it is so likely to be diminished or eliminated during forest management. Old growth provides habitat attributes that are attractive to a large number of species. Research in other areas has identified species that seem to have the highest risk of local extinction due to loss of old growth forest and its fragmentation. Of the species that are likely to occur in this area, the ones found in one or more studies to be most closely associated with old growth and therefore at highest risk are the winter wren (*Parus rufescens*) and golden-crowned kinglet (*Regulus strapa*) (Lehmkuhl and Ruggiero 1989); the brown creeper (*Certhia americana*), Townsend's warbler (*Dendroica townsendi*) and varied thrush (Sallabanks 1996); and the red-breasted nuthatch (Aney 1984, Ralph et al. 1991). Anthony et al. (1996) found that brown creepers, varied thrushes, and hermit warblers (*Dendroica occidentalis)*/Townsend's warblers were more abundant with increasing age of stands (also chestnut-backed chickadees, which aren't normally found here).

c. Fire History

The emphasis on fire suppression the past 85 years has limited the natural role of fire in forest development in the Project Area. Those wildlife species associated with post-fire habitat conditions such as the black-backed woodpecker, do not presently find attractive conditions in the Project Area.

3. Old Growth Attributes

a. Snags

Snags are an important habitat element for a wide array of wildlife species. Abundance of snags varies on forested sections of the Project Area, but large snags are reasonably abundant (estimated >3/acre) in all units except Units 9 and 10, and the lower, western portions of Unit 2, and the lodgepole stand in Unit 3. In some of the stands examined, it appears that earlier, unregulated logging has taken some of the trees that might have later contributed to the snag component.

b. Large Woody Debris

Large woody debris is also an important habitat element for many wildlife species. Just as the abundance of snags varies on forested sections of the Project Area, abundance of downed material varies too. It is reasonably abundant in at least portions of all units except the lodgepole portion of Unit 3 and in Unit 9. Down material is so abundant in the lower, central portion of Unit 7 that it would deter elk use.

4. Special Elements

a. Riparian Zones

Riparian habitat has been altered extensively throughout the Project Area through livestock grazing. Elk have probably made an impact too outside of the cattle grazing season. There is very little shrub component.

b. Rare Habitat Features

There are no bogs, fens, potholes, or particularly rare forest types within the Project Area.

B. Fine Filter: Selected Species Considered Individually

The fine filter analysis includes cumulative impacts from past and concurrent projects, including, where applicable, the Blacktail Timber Sale.

1. Species Listed under the Endangered Species Act

The possibility for habitat and/or linkage between occupied habitat in the Blacktail Mountains is examined for the bald eagle, peregrine falcon, grizzly bear, and wolf.

a. <u>Bald Eagle (*Haliaeetus leucocephalus*)</u>

The Bald Eagle is classified as Threatened. Strategies to protect it are outlined in the Pacific States Bald Eagle Recovery Plan (USFWS 1986) and the Montana Bald Eagle Management Plan (MBEWG 1994). Management direction indicated in these documents involves identifying and protecting feeding, nesting, perching, roosting, and wintering/migration areas. MDNRC primarily focuses on management considerations within 4km of active nests unless a site-specific management guideline has been developed that indicates otherwise.

Nest sites are usually as close as possible to areas with the best foraging opportunities. These are usually distributed around the periphery of large lakes and reservoirs, or linearly along forested corridors of major rivers, usually within 1 mile of shore (MBEWG 1994). These habitats are not located near the Project Area.

There are no known bald eagle nests within the Project Area (Montana Natural Heritage Database, March 1996). The nearest known nest is located on the Beaverhead River in Township 9S, Range 10W, 12 miles southwest of the Project Area. Other documented eagle nests exist in Township 12S, Range 9W (13 miles); Township 7S, Range 7W (14 miles); and Township 14S, Range 9W (22 miles). Given these distances, it is unlikely that activities on the Project Area would have any effect on nesting bald eagles. Thus bald eagles are not considered further in this analysis.

b. <u>Peregrine Falcon (*Falco peregrinus*)</u>

The Peregrine Falcon is listed as Endangered. Cliffs are generally considered preferred nesting habitat. Peregrines feed primarily on other birds and usually hunt in areas that attract a variety of bird species. Areas such as riparian zones, seeps, and marshes are preferred. Peregrines may seek riparian areas within a 10-mile radius of their nests to forage and feed their young. Like eagles they will feed on waterfowl, but unlike eagles, they will often take smaller birds that may be attracted to seeps or other microsites.

Timber harvest activities may affect peregrine foraging activity. When peregrines are nesting and feeding young (approximately March 15 - July 30), they may abandon their nest or an essential part of their home range if disturbed. This is a period when peregrines experience increased demands of nesting and feeding young and are most sensitive to disturbance.

There are no known peregrine nests on the Project Area (Montana Natural Heritage Database, March 1996), however there is some cliff habitat along the north slopes of the Blacktails that may be appropriate for peregrine falcon nesting. The nearest documented nesting pairs of peregrine falcons are along Lima Reservoir, some 20 miles distant from the Project Area.

c. Grizzly Bear (*Ursus arctos*)

The grizzly bear is listed as a Threatened species. Grizzly bears are habitat generalists and have large home ranges. Management concerns primarily focus on reducing the potential for grizzly/human interactions, which generally increase the risk of mortality for bears.

The Project Area lies outside the geographic scope of existing Grizzly Bear Recovery Zones (USFWS 1993). Recovery zones are defined as areas in which "population and habitat criteria for achievement of recovery will be measured" and which "will be managed primarily for grizzly habitat" (USFWS 1993). Thus, federal policy is that full recovery of grizzly bears is possible without occupancy of areas outside these Zones. Although grizzly bears "outside the recovery zone are listed as threatened under the federal Endangered Species Act and are protected under provisions of the Act against illegal killing" (USFWS 1993), the location of the Project Area outside of recognized Recovery Zones removes any requirement that specific Inter-Agency Grizzly Bear Guidelines (IGBC) be met even were this a federal action.

We know of no documented use of the Project Area per se by grizzly bears. Grizzly bear use of the nearby Gravelly Mountains has been documented in recent years, although many recent, reliable observations appear to be from the southeastern portion, roughly 30-35 miles east of the Project Area [unpublished map, R. Wiseman, Beaverhead National Forest (BNF), 1995]. USFS (1992) considered grizzlies in the Gravelly Mountains "at least a remnant population", although it is not clear whether such animals might alternatively represent dispersers or potential colonizers from the Yellowstone Ecosystem population. The most-recent documented observation close to the Project Area was in the summer of 1998 when a grizzly was trapped and removed from the Sweetwater Hills approximately 15 miles northeast of the project area. The second-most-recent documented observation close to the Project Area dates from 1984, when BNF staff received a reported observation by a hunter, approximately 14 air-miles due east of the eastern boundary of the Project Area.

The plausibility of the area serving as a linkage zone between the Yellowstone and Bitterroot Recovery Areas was investigated. Chris Servheen, Grizzly Bear Recovery Coordinator, USFWS (pers. comm.), stated that linkage zones should be areas capable of supporting resident populations of bears because it is so unlikely that a bear would move the whole distance between recovery areas. There is no record of any bear moving from any recovery area to another. He further stated that the region between these two recovery areas (encompassing the Project Area) is such poor bear habitat that it isn't reasonable to consider it for possible linkage zone status.

Because this area is not included within a recognized Grizzly Bear Recovery Zone (USFWS 1993), grizzly bear habitat, such as it is, will be provided for under the coarse filter approach and security provided for through mitigation for elk that includes road closures. Grizzlies will not receive further consideration in this document.

d. Wolf (*Canis lupus*)

The wolf is classified as Endangered. Like the grizzly bear, it is a habitat generalist and will occur almost anywhere that its preferred prey (most often large ungulates) is abundant and vulnerable, and that persecution from humans is tolerably low.

Similar to the grizzly bear situation, the Project Area lies outside the scope of existing recovery areas (USFWS 1987). The Project Area is, however, included within the Yellowstone Management Area (the western boundary of which is Interstate-15), a "Nonessential Experimental Population" region for wolves reintroduced into Yellowstone in November 1994 [Federal Register, 1994, Vol. 59(224): 60252-60281]. Special rules apply to wolves within this zone that are discovered attacking livestock; however, all wolves remain classified endangered. There has been a court ruling that the reintroduction of wolves into Yellowstone was not done in consideration of all legal guidelines and that the reintroduced wolves must be removed. Removal was not required immediately due to the likelihood of appeal by the USFWS. Results of the appeal are not expected before sometime in 1999 (Joe Fontaine, wildlife biologist, USFWS, pers. com.).

The fundamental biological dynamics of isolated populations apply to wolves as much as they do to any other species. Thus, the long-term viability of newly established wolf populations in Yellowstone and central Idaho ultimately may depend on connectivity with each other, and/or with other wolf populations. No official document was discovered, however, that suggested the Project Area is an "important corridor" between identified wolf recovery areas in Idaho and Yellowstone [see USFWS (1987) as an example].

Wolves appear to differ substantially from grizzly bears in their dispersal characteristics (Fritts and Carbyn 1995). Whereas female grizzly bears generally disperse relatively short distances from parental home ranges, and thus colonize range frontiers slowly, wolves exhibit both philopatric and allopatric dispersal. In particular, individual wolves are known to make occasional long-distance movements, often through landscapes that would not be expected to maintain resident populations (Mech 1995, Mladenoff 1995). Thus, over the long term, apparently isolated wolf populations appear to have the capability to maintain "connectivity" without formal designation of corridors or linkage zones.

Nonetheless, excepting only the most remote areas, the largest source of mortality affecting wolf populations comes from mankind (Fuller 1989, Thurber et al. 1994, Mech 1995). Therefore, effective linkage between patches of established wolf populations requires that mortality risk in the matrix between patches be acceptably low, allowing a sufficient number of dispersers to survive. Thiel (1985), Jensen et al. (1986), Mech et al. (1988), and Mladenoff et al. (1995) have noted the negative correlation between wolf occupancy and human habitation, as quantified by road density, in the Great Lakes region of the U.S. and Canada. In contrast, Thurber et al. (1994), working in Alaska's Kenai peninsula, concluded that although wolves avoided open, heavily traveled roads, they frequently traveled along secondary, gated, or little-used roads. Thurber et al. (1994) concluded that "Gated or seasonally closed roads away from settled

areas represent management recommendations that will provide wolf travel corridors with low human impact". Mech (1989) also noted that wolf populations could persist alongside relatively high road densities if ingress of wolves from nearby roadless areas was possible. Thus, in general, limitations to wolf occupancy arise from excessive human-induced mortality, not from roads per se (Mech 1995, Mladenoff et al. 1995).

The current situation as it relates to road density, prey base, and current wolf use is discussed below.

1) Road Density

Road density was calculated from geographical information system (GIS) coverage that was digitized from updated field knowledge of existing roads in 1997 and 1998. Currently, there is an average density of .90 mi/mi^2 open, driveable road on the Project Area and .83 mi/mi^2 open, driveable road in the Large Analysis Area. Use of these roads has been very light in the past because access to the area has been very limited due to isolation by adjacent private lands, but legal access is currently increasing.

2) Prey Base

Because ungulates are the primary prey for wolves in the Rocky Mountains (Weaver 1979), the area's elk population, especially when considered with elk of the nearby Gravelly Mountains, offers an attractive prey base for wolves. These elk could easily support a wolf pack, since a pack of six wolves may hypothetically kill an average of one elk every 5.6 days in the winter (USFWS 1987). Wolves may occasionally exert a controlling influence over ungulate population size, but this is usually not the case (USFWS 1987).

3) Current Use by Wolves

No reliable reports of pack activity or breeding had been made in recent years for southwestern Montana until October 1997 (Jim Roscoe, wildlife biologist, BLM, pers. com.). A loose-knit pack of wolves transplanted to Yellowstone and some pups were ranging widely and came into Buggy Gulch and Monument Hill areas a couple of miles south of the Large Analysis Area. They were moved back to Yellowstone National Park by the U.S. Fish & Wildlife Service (USFWS), immediately returned to the Snowcrest Mountains, and were moved again. The alpha female of the Nez Perce Pack was killed in August 1998 in the Centennials due to livestock killing on two previous excursions (Joe Fontaine, pers.com.). To date, we believe a reasonable conclusion is that any wolves that might have been observed during the past 20 years in the general vicinity represent long-distance dispersers from elsewhere in Montana or Canada. (Because natural wolf recovery has been occurring in Montana since the mid-1980's, we now have some experience with relating observational data to the status of known, breeding packs. This

experience suggests that when wolf packs use an area consistently, reports from the general public will reflect this fact. The ranging nature of this one pack that has visited a few times and the lack of reports of packs other than this one suggests that no packs reside in the area.)

e. Other T&E Species Not Considered

Other species listed by the USFWS as either threatened or endangered, and that have been documented from the state of Montana include whooping crane (*Grus americana*), piping plover (*Charadrius melodus*), least tern (*Sterna antillarum*), black-footed ferret (*Mustela nigripes*), and woodland caribou (*Rangifer tarandus caribou*). None of these species have geographic ranges in or near southwestern Montana, and thus are not considered further.

2. Sensitive Species on MDNRC Central Land Office Lands

Here, we consider each species identified as being Sensitive on the Central Land Office lands according to criteria developed in the Sensitive Species Resource Management Standards in the Implementation Guidance for the State Forest Land Management Plan. Documented presence of the species within the Project Area is not required for us to consider the species; rather, we consider the presence of habitat elements important to each listed species that could reasonably be expected to occur within this part of the Central Land Office lands.

a. Harlequin Duck (*Histrionicus histrionicus*)

Harlequin ducks inhabit fast moving, low gradient, braided streams that have segments of riffles and slow moving water with moderate to dense streamside vegetation and mid-stream loafing sites. Such habitat is not present in the vicinity of the Project Area since the streams are high gradient, generally poorly vegetated, and not braided. Additionally, harlequin ducks have not been documented from this area of the state (Montana Bird Distribution Committee 1996), so this species will not receive further analysis.

b. Ferruginous Hawk (*Buteo regalis*)

This species mainly occupies open country, primarily prairies, plains and badlands, sagebrush, saltbush-greasewood shrubland, and the periphery of pinyon-juniper and other woodland types. Preferred nesting habitat in the region is associated with willows (Rostani. 1991). This habitat is only found in the southern-most part of the project area.

c. Mountain Plover (*Charadrius montanus*)

The mountain plover inhabits shortgrass prairie habitats east of the Rocky Mountains. No such habitat exists in or near the Project Area, and no mountain plovers have been recorded from the general vicinity (Montana Bird Distribution Committee 1996), so this species will not receive further analysis.

d. Flammulated Owl (*Otus flammeolus*)

Flammulated owls breed in warm, dry habitats typified by large, old ponderosa pine and Douglas fir trees. Ponderosa pine is not present, but the Project Area does contain some large, old Douglas fir trees such as flammulated owls might use. However the area is, in general, in a colder region than where flammulated owls have been documented (Montana Bird Distribution Committee 1996). Due to the unlikelihood that it would inhabit this area, this species will not receive further analysis.

e. Boreal Owl (*Aegolius funereus*)

Boreal owls nest at high elevations (generally > 5,200 ft.) in mature spruce/fir forests, dominated by Englemann spruce, with representation by subalpine fir, Douglas-fir, western larch, and minor amounts of lodgepole pine. Mature aspen stands are also frequently used by boreal owls. Many forest stands in the Project Area possess habitat attributes such as large snags and coarse, down, woody material preferred by boreal owls (Hayward 1994), but there are no confirmed reports of boreal owl nesting within the Project Area or this latilong (Montana Bird Distribution Committee 1996). However, the Montana Natural Heritage Program (MNHP) reports indirect or circumstantial evidence of boreal owl breeding activity in Beaverhead county.

f. Black-backed Woodpecker (*Picoides arcticus*)

The black-backed woodpecker is generally associated with recently burned, or opened up, mature stands of coniferous forest. Nesting has been reported as being tied to the presence of dead trees, and management concerns have included limiting salvage sales and retaining sufficient numbers of snags. Although there are some small areas of concentrated snags, there have not been any recent significant burns in the area.

There are no confirmed reports of black-backed woodpecker nesting within the Project Area or this latilong (Montana Bird Distribution Committee 1996). However, MNHP reports indirect or circumstantial evidence of black-backed woodpecker breeding activity in Beaverhead county.

g. Townsend's Big-Eared Bat (*Plecotus townsendii*)

Townsend's big-eared bat is a widely distributed species that evidently exists in low densities wherever it is found. It appears to be sensitive to disturbance and has a low intrinsic rate of increase, making population recovery following reduction slow and difficult.

In western Montana, Townsend's big-eared bats are most-closely associated with cavernous habitat and rocky outcrops of sedimentary or limestone origin, which are used for roosting. In old growth forests, large diameter hollow trees may be used for roosting. Maternity colonies are found in warm areas of caves, mines, and occasionally buildings. Hibernacula are typically in caves or mines with winter temperatures 2-7° C and relative humidity >50%.

There are no documented records of this bat from the Project Area. However, Thompson (1982) indicates a verified specimen taken from the latilong to the east, and there are large snags that provide suitable habitat in the project area.

h. Northern Bog Lemming (*Synaptomys borealis*)

Bog lemmings in Montana are closely associated with the presence of large, thick moss mats, particularly sphagnum moss (Reichel and Beckstrom 1994). A few, small populations have also been found in other mesic sites with sedge or brush vegetation. The southernmost population documented in the Rocky Mountains is at Maybee Meadows in the Beaverhead National Forest, approximately 80 miles northwest of the Project Area. Although the possibility of finding additional populations in southwestern Montana cannot be ruled out (Reichel and Beckstrom 1994), the combination of geographic location and lack of habitats within the Project Area makes the probability of occupancy extremely low. Accordingly, northern bog lemmings will not be considered further in this analysis.

i. Lynx (*Felis lynx*)

Lynx in the Rocky Mountains are generally considered to be associated with three habitat features: i) densely stocked early successional forests (principally lodgepole pine) that create optimum conditions for snowshoe hares (*Lepus americanus*), their preferred prey; ii) dense, mature forest habitats that contain large woody debris, such as fallen trees or upturned stumps, to provide security and thermal cover for kittens, and iii) connectivity between the first two, in the form of contiguous forested cover.

Based on the above summary, the Project Area does not appear to provide high-quality lynx habitat. Lodgepole pine is not abundant and sapling stage lodgepole forests are especially uncommon (Table III-2). Finally, forested cover is naturally fragmented into relatively small patches, with the intervening matrix being made up almost entirely of open (i.e., non-forested) landscapes except for Units 7, 8, and 9. These three units are contiguous with more extensive forest, but have no significant lodgepole component whose regeneration would be attractive to foraging lynx. They don't provide viable habitat in themselves now and have little potential for the future. Thus, even under management that prioritized lynx habitat, it appears unlikely that the Project Area would support more than the occasional or accidental presence of lynx. For this reason, the project will have little influence on lynx and the lynx will not be considered further.

j. Pileated Woodpecker (*Dryocopus pileatus*)

The pileated woodpecker is a large bird that needs large snags to accommodate its nesting cavity. Snags ≥20in dbh are preferred and those 16-20in dbh provide marginal nesting habitat. When nesting and foraging needs of the pileated are met, requirements for many of the smaller species of birds, mammals, and amphibians are also met. The best habitat is a mature forest with multiple canopy layers, large snags for nesting, roosting and feeding, LWD for feeding, and large, live trees for recruitment of replacement snags (Bull 1987).

Meeting snag requirements through time becomes a challenge due to the following factors: the amount of old growth in the landscape is typically reduced through forest management, existing snags decay and fall, and large snags are not produced unless rotation lengths are long enough (Thomas 1979).

The influence of fragmentation on pileated woodpecker habitat use is poorly understood at this time, as available information seems to conflict. They have shown a moderate intolerance for stands ≤50ac (Burgess and Sharpe 1981, Rosenburg and Raphael 1986), but in eastern deciduous forests, they have shown a considerable tolerance for fragmentation as long as the total of the forested areas is large enough (Whitcomb et al. 1981). A review of pileated woodpecker research (NCASI 1987) found no definitive studies isolating minimum requirements for snag densities or fragmentation. The critical factor for a minimum requirement will probably be total area necessary as influenced by habitat size, habitat quality, forest succession, fragmentation, and maintenance of more than a minimum viable population (Haila 1986). The best management approach will be to provide old-growth and long-rotation stands that contribute toward general biodiversity goals, and (within sale units) to emphasize large snag retention and large wildlife tree retention to the extent possible (a wildlife tree being a green, but defective, tree).

The 258 acres that DNRC identified as high attribute old growth within the Project Area has good habitat attributes for nesting and foraging. The habitat arrangement may present a less-than-optimum situation because it is scattered over a large area. Suitable habitat blocks are easy to find, however, because of the openness of the intervening landscape and the mobility of these birds.

3. Game Species: Elk

Background on Elk Management

1) Habitat Needs

Biologists generally recognize the "fundamental role of elk habitat in producing and sustaining elk populations and perpetuating current levels of elk-related public recreation..." (MDFWP 1992). Four elements are identified as important: nutrition, winter range, thermal cover, and security. Nutrition is primarily a function of weather and elk population levels over which DNRC has no control. Thermal cover is primarily a concern on winter range and there is no critical winter range in the project area. The Project Area functions as spring, summer, and fall range for Blacktail Ridge elk, so we focus particularly on security concerns during calving and hunting seasons.

Elk in each herd or region tend to exhibit a preference for calving in a kind of habitat that is characteristic of that herd or region. Some herds tend to use open sagebrush areas far from timber for calving, while

others prefer the ecotone between forest and open areas (Picton 1960). When sagebrush is not available, elk tend to utilize small openings in the forest (Marcum 1975). The primary management objective for calving grounds is to provide an undisturbed period on these grounds during calving (mid-May to mid-June) and shortly after (until about July 1). The hiding period for calves is usually 10 days to 3 weeks (Knight 1970).

Elk are affected by a lack of security in at least three ways: disturbance will limit the degree to which elk utilize portions of their habitat (habitat effectiveness), disturbance in winter increases energy requirements at a critical time, and a lack of security makes elk more vulnerable to hunter harvest. When hiding cover constitutes 40% or more of the landscape and density of open roads is less than 1mi/mi^2, elk can utilize their habitat effectively [outside of the hunting season] (Lyon 1983). This density of 1mi/mi^2 of open roads is considered to be an important threshold. More recently, habitat needs for security during the fall hunting season have been more restrictively delineated and are discussed in the "Bull Elk Vulnerability" section (III3.3).

2) Hunting Objectives

One measure of the status of the elk herd is its status in relation to MDFWP's hunting objectives. Although individual land-management agencies control the types and degrees of activities occurring on the land (including access), MDFWP manages elk populations.

MDFWP has goals to maintain a five-week hunting season, spread a larger harvest throughout the season, and maintain high levels of older bulls. MDFWP would like to reach these goals primarily through maintenance of habitat security, rather than direct control of harvest through regulations and permit systems. On the other hand, DNRC provides for elk primarily through its biodiversity approach, as opposed to a concerted effort to maximize hunting opportunity.

In its Montana Elk Management Plan, MDFWP (1992) assigned numerical targets to Elk Management Units (EMU's) and to 94 elk hunting districts for elk population, harvest, and hunter recreation goals. Specifics are mentioned later in this chapter in the discussion of the current elk-hunting situation.

3) Bull Elk Vulnerability

In recent years, elk populations throughout Montana have prospered, but carry-over of bulls through the hunting season has been problematic. The issue of limiting bull vulnerability to hunting has thus generated much discussion and research. Thomas (1991) summarized management situations that contributed to increased elk vulnerability to hunting, and proposed actions to "partially offset" them (Table III-10).

Of the situations listed by Thomas (1991), MDFWP has primary authority to take management actions for numbers 2, 5, 6, 7, 8, and 10. On the Project Areas, MDNRC has principal authority for numbers 1, 3, and 4. Number 9 is a shared authority.

Christensen et al. (1993), referring specifically to managers of forested lands, listed the main issues to consider for elk vulnerability as:

1. Roads (season of use, density)
2. Security areas (distance from roads, size, cover characteristics, area closures, topographic characteristics)
3. Cover management (description, connectiveness, scale, and terrain relationships)
4. Mortality models - demonstrated predictors of elk mortality based on habitat quality, hunter density, or other factors.

TABLE III-10: Summary of problems with bull elk vulnerability, and possible solutions (Thomas 1991:319).

SITUATION	MANAGEMENT ACTION
1. Increased density of roads	Design roads to minimize impacts. Close roads permanently or temporarily. Enforce road closures.
2. Increasing density of hunters	Restrict hunter numbers.
3. Decreasing amounts of cover	Control stand configuration, juxtaposition and size through modifications in timber management program.
4. Fragmentation of cover into smaller patches	Retain adequate "escape cover" stands of several hundred or more acres.
5. No restriction on antler class in bull harvest	Impose regulations on what bulls can be taken; e.g., such as allowing the kill of spike bulls only.
6. Setting of open seasons that include the rutting period	Insure the open seasons do not include the rutting period.
7. Improving technology	Preclude "modern weapons".
8. Long open seasons	Shorten the open season.
9. Relatively gentle terrain	Decrease road density, maintain more cover, increase size of cover patches, and decrease hunter numbers.
10. Increasing number of hunter days	(Related to both items 2 and 8 above.) Reduce hunter numbers and/or reduce length of hunting season.

Hillis et al. (1991) emphasized the role of security areas in maintaining low elk vulnerability (and thus high hunter opportunity). They defined security areas as being nonlinear blocks of hiding cover at least 250ac in size, and no less than 0.5mi from any open road. They further suggested that such security blocks must equal at least 30% of analysis units to avoid increasing elk vulnerability. It should be noted, however, that most data available to Hillis et al. (1991) were from further west in Montana or Idaho, where landscapes naturally support more extensive forests than in the vicinity of the Project Area, and they cautioned that guidelines developed were intended for use west of the Continental Divide in Montana.

Christensen et al. (1992) noted, regarding the "Hillis paradigm," that "...there appears to be a gradient from west to east regarding the significance of cover in this equation. In northern Idaho...cover is so ubiquitous that security can be controlled with road management alone. As you move east...over the Continental Divide, cover considerations become more important because cover is less abundant and less contiguous." Later, Christensen et al. (1992) urged consideration of cover in the "more naturally open elk habitat in central and southwestern Montana...where...a landscape-level perspective is absolutely necessary". Size, location on the landscape, connectivity with other cover, and vegetative composition are important considerations (Hillis et al. 1991). Data from Montana hunting seasons (Lyon and Canfield 1991) suggest that elk are less selective about the specific vegetative characteristics of coniferous cover and more responsive to size of units, connectivity with adjacent units, and the scale of cover on the landscape.... "Where coniferous cover may be a limiting factor, it will be important to develop long-term perspectives (rotation length) on cover management that address condition, quantity, location, and configuration".

Thus, retaining cover is often cited as an important element of elk security, particularly in habitats such as are found in the Project Area. Nonetheless, there are suggestions in published literature that managing hunter density through road management alone may help achieve harvest objectives, even in similarly open areas. Working approximately 15 miles northeast of the Project Area in the Gravelly mountains, Basile and Lonner (1979) noted that hunting pressure and proportion of elk killed became more equitable through the general season after an area had been closed to vehicle traffic. Because the number of hunters entering the restricted area during the early portion of the season was significantly less than the number entering a similar, unrestricted area, elk apparently stayed in the former area longer. Basile and Lonner (1979) concluded that, for this particular study area, "...travel restrictions appeared to increase the capability of the area to hold elk".

b. Affected Elk Population

Since 1984, MDFWP has been conducting research entitled "Gravelly-Snowcrest Mountains Elk Study - Elk Population Dynamics and Breeding Biology" (PR Project W-100-R-3; see Hamlin and Ross 1995). It was expanded in 1989 to include the Blacktail Ridge herd. Information concerning elk in the Project Area comes from those elk that winter along the lower timber line from Riley Creek eastward on the north slopes of the Blacktail Mountains (Blacktail Ridge Herd), from hunter harvest surveys, and from aerial surveys. Some elk on this winter range were fitted with transmitters. It is believed that this wintering herd provides most of the spring-summer-fall population of the Project Area, but some elk wintering to the west in Clark Creek probably mix with them (B. Brannon, MDFWP, pers. comm.).

1) Current Habitat Situation

Because the Project Area functions as spring, summer, and fall range for the Blacktail Ridge Herd but does not function as winter range, and hunting season security is discussed in another section, we will focus particularly on security concerns during calving season in this section.

Blacktail Ridge elk concentrate their calving activity in the non-forested areas at the heads of drainages, particularly Clark Canyon, Long, Divide and Sage Creeks (B. Brannon, MDFWP, pers. comm.). Because of the limited public access, lack of developed trails and other facilities, and lack of highly attractive point destinations such as lakes for fishing, it is unlikely that this area attracts much public visitation outside of hunting season. Security for calving elk has not been an issue to date.

2) Current Elk Hunting Situation

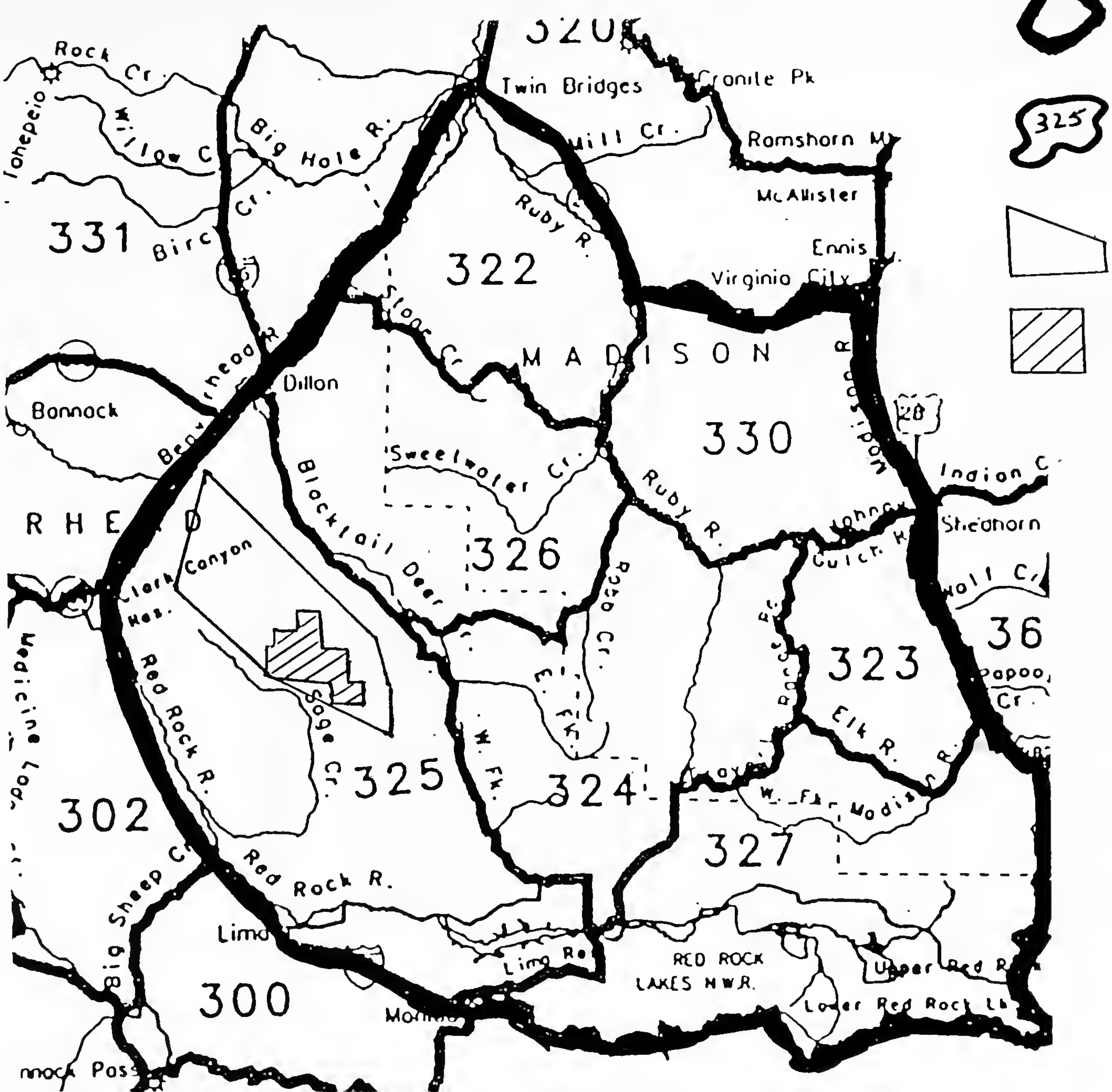
MDFWP has defined Elk Management Units (EMU's) throughout the state of Montana; the Project Area is situated within the Gravelly EMU (approximately 1800 mi^2). Within each EMU, Hunting Districts (HDs) further refine management. HD 325 encompasses the analysis area and is bound by the Blacktail Deer Creek Road to the northeast, down to the east side of, and then south of, Lima Reservoir, over to Monida, then up to Dillon along Interstate 15 (there are 5 other HDs within the EMU).

Hunting regulations over the last 20 years within the Gravelly EMU have gone from either-sex seasons to antlered bull to branch-antlered bull to brow-tine bull. Branch-antlered bull (BAB) regulations were first introduced in 1981 in HD 324 in an attempt to reduce the number of bulls harvested and help increase the low bull:cow ratios observed on the winter range (Hamlin and Ross 1991).

By 1987, all hunting districts in the EMU (including HD 325) had adopted branch-antlered bull regulations. A high illegal mortality rate of spike bulls was noted under these regulations (Hamlin and Ross 1991). In 1990, all branch-antlered bull regulations were changed to brow-tine bull in an attempt to reduce the illegal mortality of spikes. All cow harvests are now by permit only.

Figure - III-5
ELK HUNTING DISTRICTS

Gravelly Elk Management Unit



- Gravelly Elk Management Unit
- Hunting District Boundaries
- Large Analysis Area
- Project Area

Management objectives (listed in italics below) that have been quantified (MDFWP 1992) for the Gravelly EMU and the current status of goal achievement include (B. Brannon, MDFWP, letter dated January 8, 1997; Hamlin and Ross 1995, and Terry Lonner, MDFWP):

--*Total population goals of 8,000-8,500: 8,857 elk were* counted for 1996-1997. When the harvested animals are added, it indicates a 1996 pre-season total population estimate of 11,566. This represents approximately a 77% increase since 1980 and an even larger magnitude increase from historical (late 1940's) population levels (Hamlin and Ross 1994). Counts on the principal winter ranges suggest that the population remained approximately stable or increased slightly in the early 1990's (Hamlin and Ross 1994), but there seems to have been a large increase since 1997 because of a light 1997 harvest and a light winter afterwards.

-- *Late-winter calf:cow ratio goal of at least 45:100.* Calf:cow ratio was 37:100 from winter-spring ground observations 1995-1997. There was a very bad year in 1996 with only 22:100.

-- *Harvest goal of 700-900 antlered and 800-1100 antlerless elk:* In 1994-1996, an average of 1,005 antlered and 1,378 antlerless elk were harvested (161 and 274, respectively, for HD 325). Total harvests have varied from approximately 1,250 to 2,850 elk annually. Bull harvests in recent years have varied from a low of 549 in 1990 to a high of 1,255 in 1994 (B. Brannon, MDFWP, letter dated January 8, 1997).

--*Hunting recreation goal of 34,700 days annually for a minimum 3,600 hunters*: Hunting recreation for 1996 was 51,235 hunter days for 10,597 hunters (7643 and 1633, respectively, for HD 325). The Gravelly EMU has among the highest number of hunters of any EMU in Montana (MDFWP 1992). The EMU has provided up to 57,000 days of hunter recreation to a maximum of about 11,000 hunters (MDFWP 1992).

--*Temporal distribution of harvest-- no more than 40-45% of harvested bulls are taken during the first week*: Three-year average 1994-1996 has been 47% (43% for HD 325). During only 3 of the past 10 general hunting seasons has the percentage of bulls harvested during the first week been as low as the hoped-for 45% (5 of 10 for HD 325) (Table III-11).

Recent reports indicate that total population and harvest targets are being exceeded (Hamlin and Ross 1995; B. Brannon, MDFWP, letter dated January 8, 1997).

TABLE III-11: Percentage of harvested bulls taken during the first week of the general season, success rate for bulls, total bulls harvested, and total elk harvested within the Gravelly EMU, 1986-1994. Data courtesy of B. Brannon, MDFWP, letter dated January 8, 1997, and Terry Lonner dated February 11, 1998. Data not available for 1997 as of this writing, including bull-hunting success rate for 1996.

Year	% Bulls Harvested First Week	Bull Hunting Success Rate	Total Bulls Harvested	Total Elk Harvested
96	44	--	1,125	2,709
95	51	8	635	1577
94	46	16	1255	2868
93	65	10	525	1525
92	47	12	736	1847
91	48	19	1080	2197
90	52	10	549	1263
89	44	12	677	1531
88	42	16	797	1669
87	55	14	722	1395
86	51	14	672	1261

3) Elk Security in and near the Project Area

Because of the relatively gentle topography, number of roads accessible to four-wheel drive vehicles, and predominance of open grassland habitats, the Gravelly EMU generally has inherently low security for bull elk during hunting seasons. This relatively low security is one reason that the targeted percentage of bulls harvested during the first week is 45% (rather than a lower figure, which is more common in other EMUs with higher security). Only 9.8% of the Project Area and 25.0% of the Large Analysis Area are forested. An analysis of security cover fitting the Hillis Paradigm (forest cover blocks .5mi or farther from roads and 250ac or larger in size) indicated that six stands fit the criteria in the Large Analysis Area and no stands fit the criteria in the Project Area.

Christensen et al. (1993) emphasized the importance of configuration and connectivity of cover patches for elk security. Patches of cover in the Project Area are naturally small and discontinuous except Units 7, 8, and 9, which are contiguous with stands outside of the Project Area. Small patches make it difficult to achieve effective security based on vegetative characteristics alone.

The central portion of the Project Area, however, has historically had less public access than some of the Gravelly EMU due to its isolation by private lands whose owners discouraged access. Current road density in the Larger Analysis area is .83mi/mi^2, and in the Project Area is .90mi/mi^2, and these roads were very lightly utilized until recently. The only consistent access permission was in the lower elevations which

necessitated walking many miles and pulling 1000 to 2300ft of vertical to reach most of the Project Area. But, the situation is changing somewhat. A hunter access group has leased the right for the public to cross private land at the east end, which is driveable when there is no snow, and the BLM has secured access in the western half of the Large Analysis Area and is improving roads in 1999.

4. Other Game Species

Other large mammal species known to use the Project Area include mule deer (*Odocoileus hemionus*) and moose (*Alces alces*). Moose use riparian areas and occasionally winter in dense stands dominated by Douglas fir and Englemann spruce. The needs of moose should be met by implementation of the Coarse Filter for biodiversity.

Mule deer use predominately open habitats in the Project Area. The greatest habitat management concern for mule deer revolves around winter range. Since mule deer winter range will not be affected by the project, needs of mule deer should be met by the Coarse Filter.

Since the needs of these game species will be met under all Action and No Action Alternatives, they will not receive further examination in this document.

VI. RECREATION

The Blacktail Mountains receives very little recreational use outside of the general big game hunting season. Long Creek supports a typical brook trout fishery and is occasionally used by anglers but is not heavily fished.

State lands are available for non-motorized recreational use to anyone purchasing a Recreational Use License for State Lands. Licenses are not site specific and allow use of all legally accessible state lands. Therefore, it is very difficult to determine the amount of recreational use and income resulting from license sales for a specific area. Statewide, from March 1, 1997 through February 28, 1998 (the recreational use licensing year), 33,051 General Recreational use Licenses were sold, producing $340,107. The Department may also issue a Special Recreational Use License for concentrated activities such as outfitting on state lands. One Special Recreational Use License for hunting outfitting has been issued for 8,920 acres within the project area. This license produced an income of $892.00 in 1998.

The access roads to the project are not maintained in the winter. Consequently recreational use from December through April is generally limited to occasional snowmobiling.

VII. GRAZING RESOURCES

The state lands within the project area are classified grazing and are leased for livestock use on an animal unit month (AUM) basis. Grazing leases are generally issued for a 10-year period and are open for competitive bid. During the past five years a total of 3035 AUM's per year for cattle

use has been leased in the project area under 7 leases and to 3 separate lessees. The leases were field evaluated individually from 1986 through 1996. All leases were considered to be in good condition with static or upward trend and slight to moderate forage utilization overall. A grazing plan has been instituted with the lessee to improve riparian conditions on Long Creek . The following table summarizes the five-year grazing history of the project area.

TABLE III-12: Grazing income summary for the project area.

	1994	1995	1996	1997	1998
AUM's	3,440	3,035	3,035	3,035	3,035
Rate	$ 4.09	$ 5.15	$ 4.53	$ 3.60	$ 4.01
$ Income	$14,069.60	$15,630.25	$13,748.55	$10,926.00	$12,261.40

VIII. TRANSPORTATION

The primary access route to the project area is from the southwest along a high standard, gravel surfaced road maintained by Beaverhead County approximately 20 miles in length from Dell to the BLM's Crooked Creek Road (#1845), then along the Crooked Creek Road to the Project area. The Crooked Creek Road is not maintained during the winter and generally drifts shut from December through April but is open for public use throughout the spring, summer and fall. The other access to the project area is from the southeast along a four wheel drive road via Woods Canyon from the Blacktail County road.

There is an estimated 28.7 miles of existing road within the project area. The roads are low standard or four wheel drive trails located on state, private and federal lands. These roads are generally open for ranching or land management activities and are used to varying degrees for recreational activities. Roads on state lands are closed to public motorized use unless designated open by the Department. One of the roads, and one spur of this road within the project area have been designated open. Signs have been posted at locations within the project area notifying the public of road use restrictions. The Woods Canyon road is open for recreational use from the Blacktail County Road through the project area to a locked gate on private land at the south boundary of section 20, T10S, R08W with 10.9 miles of open road in the project area. A spur of this road approximately one mile in length on state land is also open to recreational use. An estimated 1.25 miles of this spur road is located within the project area on land administered by the Bureau of Land Management and is open for recreational use May 16 through December 1. The remaining low standard roads, located on state and private lands are administratively closed to public motorized use. However, unauthorized use occasionally occurs, primarily during the hunting season.

Most of these roads are poorly located, are not maintained, have unimproved stream crossings and consequently pose sedimentation and water quality problems.

IX. CULTURAL RESOURCES

A cultural resources inventory of the project area with emphasis given to those areas that would be disturbed under each alternative was conducted in 1997. Five cultural resource sites were identified (24BE1844-24BE1848) and recorded. These sites consist primarily of chipped stone tool debitage. Only one of the sites has been evaluated for it's significance or eligibility for listing in the National Register of Historic Places. A formal cultural resource evaluation was conducted on this site and the State Historic Preservation Office (SHPO) concurs that the site is not significant. There is also the potential for deeply buried cultural resources in this vicinity; however, deeply buried sites are not likely to be disturbed under any of the harvest proposals.

X. ECONOMICS

A. TRUST REVENUE

School Trust Lands are held by the State of Montana in trust for the support of specific beneficiary institutions such as public schools, state colleges and universities and other state institutions such as the School for the Deaf and Blind. Statewide, in fiscal year 1997, there were approximately 5,146,917 surface acres of school trust land (6,343,235 acres mineral estate), generating income of more than 60.6 million dollars.

The 11,671 acres of school trust land within this project area are held in trust specifically for the benefit of common schools. They are classified grazing lands managed principally for their grazing resource values. Revenue from the grazing leases in the project area has averaged $13,327 per year over the past 5 fiscal years and generated $12,261.40 in fy 1998. In addition, the Department, in 1996 issued a Recreational Use License for Outfitting on approximately 3,360 acres inside the project area that generates approximately $892 annually. In 1993, the Price Canyon Timber Sale generated an income of approximately $16,700.

CHAPTER IV
ENVIRONMENTAL EFFECTS

I. GENERAL DESCRIPTION:

The Blacktail and Sage Creek Valleys would not change substantially as a result of implementing any of the action alternatives. The valleys would remain remote. Grazing would remain the primary land use of the area.

II. VEGETATION:

Under Alternative A, approximately 33% of the forested area on state lands in the project area would be included in harvest units. An estimated 25% to 70% of the live volume would be harvested from ten stands. The primary species harvested would be Douglas fir, Engelmann spruce, and lodgepole pine. Six units (1,5,8,9,10,11) would be harvested with a helicopter yarding system, and four units (2,3,4,7) would be harvested with conventional ground based systems. There would be four general types of treatment that would result in somewhat different residual stand types:

> Treatment 1--Approximately 63 acres of primarily Douglas fir timber type would be harvested removing approximately 70% of the volume so that the residual stand would consist of approximately 14 to 20 trees per acre, consisting of dominant Douglas fir over 16" dbh that are greater than 170 years old. The remaining stands would contain patches of submerchantable, seedling, sapling or pole sized material.
>
> Treatment 2--On an estimated 149 acres of primarily Douglas fir timber type harvest would remove approximately 50% of the volume leaving the residual stand with approximately 35 trees per acre that are >7 inches in diameter with only a few (1 to three per acre) larger diameter (>19") trees that are scattered throughout.
>
> Treatment 3--Approximately 118 acres of primarily spruce-fir stands would be treated through a group shelterwood system. Harvested groups would be 1 to 2 tree lengths in diameter (approximately ¼ to ½ acre in size) scattered throughout the stand, actually harvesting a total of approximately 25% of the stand area. This treatment would also minimize risk of windthrow and frost pockets (Alexander, 1987).
>
> Treatment 4--An estimated 46 acres of lodgepole pine timber type would have all lodgepole removed and leave a residual stand of approximately 5 Douglas fir and Engelmann spruce trees per acre.

Under Alternative B, all yarding would be ground based, through tractor or cable machine. Approximately 25% to 70% of the live total volume in seven stands (1,2,3,4,5,7,8) would be harvested from an estimated 31% of the forested area on state land. The residual stands would be similar to those described under Alternative I for each treatment type with acreages as follows:

> Treatment 1-- 55 acres
> Treatment 2-- 121 acres

Treatment 3-- 118 acres
Treatment 4-- 46 acres

Alternative C would not treat the stand in the Riley Creek drainage. Under this alternative all units would be yarded through tractor or cable systems. An estimated 25% to 35% of the total live volume from six stands (1,2,3,4,5,8) representing 24% of the forested area on state land within the project area, would be harvested. The residual stands would be similar to those described in Alternative I for each treatment type with acreages as follows:

Treatment 1-- 55 acres
Treatment 2--121 acres
Treatment 3-- 60 acres
Treatment 3-- 46 acres

Alternative D would not treat the stands in the Cottonwood Creek drainage. Under this alternative all units would be yarded through tractor or cable systems. An estimated 25% to 35% of the total live volume from six stands (1,2,3,4,5,7) representing 24% of the forested area on state land within the project area, would be harvested. The residual stands would be similar to those described in Alternative I for each treatment type with acreages as follows:

Treatment 1-- 0 acres
Treatment 2-- 121 acres
Treatment 3-- 118 acres
Treatment 4-- 46 acres

A. Forest Types, Successional Stages and Fire History:

1. <u>Forest Types and Fire History</u>

a. No Action

The No Action alternative would result in no appreciable change in forest types in the near term. Existing succession patterns would continue, but most Douglas fir stands would continue to be dominated by Douglas-fir for the foreseeable future, with a slow trend of increasing numbers of shade-tolerant trees such as spruce and sub-alpine fir. Spruce - fir stands would continue to trend toward a climax subalpine fir stands. A greater than natural proportion of the forest consists of spruce and sub-alpine fir and has multiple tiers of canopy. This trend is likely to continue. However, current stand conditions are very conducive for natural stand replacement disturbance. Overstocked, multi-storied Douglas fir and Engelmann spruce stands in dry climates are very susceptible to Western Spruce Budworm infestations. The likelihood of an outbreak in this vicinity during the next fifty years is high due to the abundance of overstocked Douglas fir timber types that exist in the region. Tree mortality from insect

infestations would contribute dead and downed woody fuels, creating conditions that are ripe for large stand replacement fires. Consequently the likelihood of a large fire event would increase substantially over time. A fire occurring in stands under the No Action Alternative would likely be a stand replacement fire, reverting the forested stands to primarily a grassland-sage cover type with possibly some few scattered old remnant trees that survived due to microsite conditions or location.

b. Action Alternatives

None of the Action Alternatives would produce fundamental changes in classifications of forest types except in one area-- in the lodgepole pine of Unit 3, where all alternatives call for removing lodgepole and leaving the large, old, scattered Douglas fir. In other areas where there would be harvest in Douglas fir types (except Units 8 and 9), forest types post-sale would more closely resemble historical conditions because shade-tolerant trees would be mostly removed from the mix and the understory would be somewhat more open. Units 8 and 9 would more closely resemble stands after a disturbance. All spruce-fir stands treated in action alternatives would use small group shelterwood harvesting to emulate natural small-scale disturbance events. All action alternatives would reduce the likelihood of stand replacement events occurring by reducing the stands' susceptibility to insect and disease infestations and subsequent fuel build-up, and reducing fuel loadings of the stands.

None of the Alternatives provides for a natural fire regime; fire suppression would continue as Departmental policy. However because of the area's remoteness, response to fire ignition would probably not be immediate. Under the No Action Alternative, the probability of an ignition causing a large crown fire would be higher than under the remaining Alternatives, because Action Alternatives would reduce existing build-up of ladder fuels. Such a fire in the area would be more likely to consume a larger acreage of mature forests than under a natural fire regime.

Cumulative Effects

No cumulative effects from other actions are expected relative to forest types. Past harvests have either been a partial cut that maintained the existing cover type or have regenerated to the previous type. The Blacktail sale of which a portion is within this analysis area will be a very light harvest that will not affect forest types.

2. Successional Stages

a. No Action

The No Action Alternative would result in continued succession toward climax unless fire or other disturbance intervened to move succession

back to the seedling stage. Little change would be expected within stands currently categorized as old growth.

c. Action Alternatives

The silvicultural treatments proposed for Douglas fir cover types under each action alternative are primarily designed to reduce stocking levels. Most stands would continue to be characterized by the overstory. Therefore the successional stage classifications of Douglas fir stands would not change substantially as a result of implementing the action alternatives. However, conditions would more closely resemble those that we believe historically existed because the understory would be more open into the current condition. The successional stage classification of lodgepole pine types would change from an old stand classification to a non-stocked/seedling classification.

Alternatives A, B and C

Proposed treatments under Alternatives A, B and C would essentially convert 46 acres of lodgepole pine and 63 acres of Douglas fir in Units 8 and 9 that are currently classified as high attribute old growth to a non-stocked/seedling condition. The result would be to convert all of the old stand lodgepole pine within the project area to a non-stocked seedling stage. The Douglas fir old stand acreage would be reduced from approximately 900 acres to 837 acres.

While many stands in the project area have old trees in scattered patches, as individuals or clumps, some old growth in the project area, have structural attributes such as large downed woody debris and snags that may be an important habitat component for some wildlife species. For lack of a better term, we have identified those stands with more snags and woody debris as high attribute old growth to achieve diversity in the post-harvest old stand classification and ensure that some representation of the range of pre-settlement conditions would exist after harvest. This high attribute old growth acreage is typically portions of old growth that, due to microsite conditions, have a higher percentage of large diameter trees, woody debris and greater potential for snag recruitment.

Based on ground reconnaissance, we estimated there are 258 acres of high attribute old growth in the analysis area. An estimated 22 acres of high attribute old growth in Units 8 and 9 (not all acres in these units are high attribute old growth) would lose its old growth qualities under Alternatives A, B and C where the silvicultural treatment would resemble a seed tree harvest (but retaining large old trees, many snags and woody debris). Additional old growth acres throughout the project area would be selectively harvested and Unit 7 (not proposed for harvest under Alternative C) would have ¼ acre patches removed. However, the best indications are that old growth areas other than those in Units 8 and 9 should continue to attract old growth associated species, since they

would retain old growth attributes and in our opinion, would more closely resemble old growth at the turn of the century. The only old stand in the project area that we considered as entirely composed of old growth was omitted from harvest under all alternatives (50 acres in Section 10).

Alternative D

Alternative D does not propose to harvest in Units 8 and 9. Therefore the only reduction in old stand classification would occur in the lodgepole pine type. Similar to the other action alternatives, all of the lodgepole pine old stand type (46 acres) in the project area would be converted to a non-stocked/seedling condition.

Acres identified as old growth by ground reconnaissance would not lose its old growth qualities under this alternative since Units 8 and 9 would not be harvested and other areas would be harvested in a manner similar to Alternatives A, B and C.

d. Cumulative Effects

An estimated 4% (78 acres) of the forested land within the project area has been harvested during the past 50 years. That includes the 45 acre harvest on state land in 1993 and the 33 acres on private land in 1987. The state harvest was conducted in a stand that was classified in the DNRC inventory as a pole stand (41-100 years old) but had scattered patches of overmature (200 year old) trees. The stand was commercially thinned and is still classified as a pole stand. The private harvest was clearcut.

A comparison of Losensky's data in Beaverhead and Madison Counties with the current inventory on state land can be used to evaluate the cumulative impact of timber harvests on state land in the entire Dillon Unit. Table IV-3, displays the post harvest classification of forest stands within the Dillon Unit and Losensky's data of historic conditions in Beaverhead and Madison counties. The data indicates, under all alternatives, the forested stands for all cover types on state land would be older than anticipated, after harvest, when compared to historic conditions.

Table IV-1 Percentages of area by cover type and age class. Historic figures are from Losensky (1997) and represent an estimate of conditions that existed in the year 1900 in Beaverhead and Madison Counties. Current figures are extrapolated from DNRC inventory data (63% complete) and represent the forested area on state land in Beaverhead and Madison counties. The data includes an estimate of the effects of all DNRC timber sales that have been harvested or sold in the Dillon Unit. Post harvest figures represent the expected condition after harvest under each alternative in this sale proposal.

Cover Type (Stand Age in years)		**Non-Stocked & Seedling/Sapling (0-40)**	**Pole (41-100)**	**Mature (101-OS*)**	**Old growth (OS)**
Douglas Fir	Historic	33%	28%	13%	26%
	Current **(No Action)**	7%	26%	18%	49%
	Post Harvest **Alt. A, B, C**	8%	26%	18%	48%
	Alt. D	7%	26%	18%	49%
Spruce-Fir	Historic	4%	41%	22%	33%
	Current **(No Action)**	2%	40%	18%	40%
	Post Harvest **All Alternatives**	2%	40%	18%	40%
Lodgepole	Historic	50%	41%	8%	1%
	Current (No Action)	22%	39%	15%	24%
	Post Harvest **All Alternatives**	24%	39%	16%	22%
Average of Forest	Historic	35%	34%	13%	19%
	Current (No Action)	11%	31%	17%	41%
	Post Harvest **Alt. A, B, C**	12%	31%	17%	40%
	Alt. D	11%	31%	17%	41%

Table IV-2 Acres of high attribute old growth that are within harvest units.

Old Growth Type	Acres of High attribute old growth Within Project Area	Acres of High attribute old growth Within Harvest Units	Acres of High attribute old growth Losing Attributes After Harvest	Percentage of High attribute old growth Losing Attributes After Harvest
Alternative A	258	170	22	8%
Type 2	96	74	22	23%
Type 9	62	96		
Alternative B	258	153	21	8%
Type 2	96	57	21	22%
Type 9	62	96		
Alternative C	258	113	22	8%
Type 2	96	57	22	23%
Type 9	62	56		
Alternative D	258	136	0	0
Type 2	96	40	0	0
Type 9	62	96	0	0

Timber harvest in the past 40 years has affected only 4% of the forested land in the project area. There are an additional 20 acres of privately owned forest land in the project area that the landowner has indicated may be harvested in the near future. Consequently the risk of cumulative impacts from timber harvest in the project area is very low.

B. Insect and Disease

1. Western Spruce Budworm

All of the action alternatives would reduce the likelihood of a spruce budworm infestation in harvested stands. The post treatment stands would be somewhat less susceptible to Spruce Budworm infestations since primarily healthy, well-spaced trees would remain. Open stands are less likely to sustain budworm populations and generally, silvicultural practices that encourage tree growth, increase tree vigor and produce a mosaic of age classes in a drainage would encourage resistance to spruce budworm infestation (Carlson et. al., 1983).

The likelihood of a spruce budworm infestation would be expected to increase in unharvested stands under the no action alternative as the stands move toward a multistoried, multiage condition.

2. Dwarf Mistletoe (*Acethobium americanum*)

Under the No Action alternative Dwarf Mistletoe would be expected to increase in the infected lodgepole stands in the area. This would lead to further decreases in growth of the infected trees, and a probable increase in mistletoe-caused mortality. All action alternatives propose harvest of 46 acres of the 57 total acres of lodgepole pine on the State ownership. This harvest would remove infected

trees from the area harvested and allow the area to regenerate to healthy, uninfected trees. Over time some re-infection of the area can be expected from the adjoining unharvested stand, and from infected trees in the unharvested buffer area surrounding the stand.

3. Spruce Bark Beetle (*Dendroctonus rufipennis*)

Under the No Action alternative, the stands containing spruce would likely see mortality continue to occur, primarily in the larger spruce. Individual tree and group mortality would produce small openings in the canopy that would allow the regeneration of some spruce, however, over time, the stands would be expected to continually decrease in the amount of spruce, and increase in the amount of subalpine fir that they contain.

All action alternatives would reduce the number of large spruce within the stands. This would reduce the number of trees susceptible to beetle attack, and prevent the possible value loss to beetle mortality of the trees removed through logging. All action alternatives have the potential to increase beetle numbers in the slash created by logging in the spruce-fir stands. Burning the slash the year following logging can reduce this hazard.

4. Western Balsam Bark Beetle (*Dryocoetes confusus)*

Western Balsam Bark Beetle group mortality would be expected to continue to occur in the subalpine fir under the no action alternative. Beetle activity would be expected to increase over time as succession increases the relative amount of subalpine fir in the stand.

Action alternatives that harvest in spruce-fir stands would be expected to decrease Western Balsam Bark Beetle susceptibility since the areas harvested will regenerate primarily to spruce.

C. Sensitive Plant Species

No species of special concern were noted during surveys of sites that would be impacted by the action alternatives. If a plant species of special concern is found in the area that could be impacted by the project, mitigation measures would be developed.

D. Noxious Weed Management

No noxious weeds were observed in the proposed harvest area. Under the no-action alternative, the most likely introduction of noxious weeds would be through recreational traffic, which would require treatment, using recreational access funds.

Under all action alternatives DNRC would employ reasonable efforts to prevent the introduction and establishment of noxious weeds following an Integrated Weed Management approach for this project. A combination of prevention, revegetation, and

monitoring will be implemented to reduce the possible infestation and spread of weeds associated with this project with all action alternatives. The likelihood of introduction through recreational use would be similar to that anticipated in the no action alternative. Consequently weed infestations are anticipated to be minor and temporary.

III. WATERSHED AND FISHERIES:

A. HYDROLOGIC AND FISHERIES EFFECTS ANALYSIS

This section discloses the anticipated effects to water and fisheries resources within the affected environment from proposed activities. The primary concerns related to aquatic resources within the affected environment are potential impacts to water quality and effects on fish populations within the Cottonwood Creek, Long Creek, and Divide Creek watersheds. In order to address these issues the potential effects of each alternative on fine sediment production, water yield, large woody debris recruitment and fish passage were analyzed.

1. LARGE WOODY DEBRIS RECRUITMENT

Large woody debris (LWD) is an important physical and biological component of forested streams. Numerous studies have documented LWD as an important source of habitat and cover for salmonid fish populations in forested streams (Sedell et al., 1984; Bisson et al., 1987; Sedell et al., 1988). One of the key functions of LWD with regard to fish production is to increase habitat complexity, and this helps ensure that cover and suitable habitat can be found over a wide range of flow and climatic conditions (MacDonald 1991).

Decreased levels of instream and recruitable LWD can result in a reduction in both the number and area of pools, which in turn may affect juvenile salmonid abundance and/or species age-class distribution (Beechie and Sibley 1977). Typically, logging of riparian forest corridors reduces the rate of LWD recruitment to a stream for several decades (Grette 1985; Murphy and Koski 1989; Bilby and Ward 1991). Depletion of instream LWD continues during the period of little or no recruitment, resulting in a net decline in LWD abundance for several decades (Grette 1985) and sustained low amounts of LWD between 50 and 100 years after logging (Murphy and Koski 1989).

a. Effects Common to All Action Alternatives-

The anticipated effects of the proposed activities are not expected to reduce current and future levels of recruitable large woody debris to stream channels within the affected environment. Due to the presence of westslope cutthroat trout in the Cottonwood Creek and the possible presence in the Long Creek drainages, harvest will be deferred from the Streamside Management Zones located within these watersheds. Proposed activities within all of the affected watersheds will comply with the Montana Streamside Management Zone Law (77-5-302 MCA) and applicable watershed and fisheries resource management standards outlined in the State Forest Land Management Plan Record of Decision (1996).

b. Alternative E: No Action

No timber harvest would be conducted under this alternative. Licensed grazing and recreational activities would continue. No timber revenue would be generated and the site would not be reevaluated for timber harvest until the existing circumstances change. As a result, the No Action alternative would affect existing and future levels of large woody debris recruitment to streams within the analysis area.

2. WATER YIELD

The effects of forest management activities on water yield have been extensively studied in a number of experimental watersheds. These studies have demonstrated that removing forest cover increases water yield and that the magnitude of this increase is proportional to the amount of vegetation removed and also on water availability (Hibbert, 1967; Megahan, 1976; Troendle, 1987). Water yield increases have the potential to effect downstream beneficial uses by increasing the magnitude, frequency and timing of peak flows. The watershed response to increased water yields may potentially include channel destabilization, decreased instream habitat and cover, and loss of dynamic equilibrium. Dynamic equilibrium is defined as when a stream's energy is at a level that allows sediment loads entering a stream to equal those leaving it.

A. Effects Common to All Action Alternatives

The risk of detrimental increases in water yield due to the proposed activities is low under all action alternatives for all of the affected watersheds. This conclusion is based on natural and existing levels of forest crown cover, low annual basin precipitation, and the partial crown removal prescriptions of the proposal. As noted in the Existing Condition report (Tables III-I, III-5 and III-6), a majority of each watershed is in a naturally non-forested condition, thus activities associated with all action alternatives will not result in a detectable or substantial increase in water yield. Table IV-3 displays estimated increases in cumulative watershed equivalent clearcut acres (ECA) by alternative.

Table IV -3: Existing and Estimated Cumulative ECA by Alternative

Watershed	Watershed Acres	Existing Cumulative ECA	Alternative A ECA	Alternative B ECA	Alternative C ECA	Alternative D ECA	Alternative E ECA (No Action)
Cottonwood Creek	4,325	Negligible	(+52)	(+46)	(+46)	(+0)	Negligible
East Fork, Cottonwood Creek	1,326	Negligible	(+52)	(+46)	(+46)	(+0)	Negligible
Long Creek	4,791	2	45 (+113)	104 (+102)	108 (+106)	108 (+106)	2

b. Alternative E: No Action

No timber harvest, road construction, or road improvement activity would be conducted under this alternative. Barring catastrophic wildfire, existing forest canopy cover levels would likely increase due to regeneration, fire suppression and range encroachment. Management induced changes in water yield would not occur under the No Action alternative.

3. FINE SEDIMENT PRODUCTION-

Land management activities such as road construction and timber harvest can potentially increase levels of fine sediment delivery to streams if not properly designed and mitigated. Numerous studies have documented the effects of suspended sediments on beneficial uses and salmonid fishes (MacDonald 1991; Sorensen et al. 1977; Albaster and Lloyd 1982). The primary effects are: (1) acting directly on free-living fish, either by killing them or by reducing their growth rate or resistance to disease, or both; (2) interfering with the development of eggs and larvae; (3) modifying natural movements and migrations of fish; and (4) reducing the abundance of food organisms available to the fish, such as aquatic invertebrates and periphyton (Newcombe et al. 1991). Increased levels of fine sediment deposition have also been correlated with survival-to-emergence success of developing salmonid fry (Stowell et al. 1983). Fry survival-to-emergence rates of 80-90% when fine sediments constitute <10% of a redd drop to 15-55% when fines exceed 30% .

a. Timber Harvest Units

Erosion and potential sediment delivery to streams and ephemeral drainages from timber harvest units can be mitigated by the type of harvest and yarding method utilized (ground-based skidding, cable yarding, helicopter yarding). In general, ground-based operations have higher potential to cause localized erosion within harvest units and from skid trails than cable and helicopter yarding methods. Erosion and sediment delivery are most likely to occur at landings, temporary roads, and skid trails. Designation of skid trails and implementation of appropriate BMPs and mitigation measures will be used to reduce the risk and severity of soil erosion and sediment delivery to drainage features under all action alternatives. In addition, SMZ buffers will be designed to effectively filter sediment derived from units located adjacent to stream channels

Tables IV-4 and IV-5 list harvest unit acreage by harvest method (yarding method utilized) for each alternative in Long Creek and Cottonwood Creek.

Table IV-4: Harvest Acreage and Harvest Method by Alternative: Long Creek Watershed

HARVEST METHOD	ALTERNATIVE A	ALTERNATIVE B	ALTERNATIVE C	ALTERNATIVE D	ALTERNATIVE E No Action
Ground-Based Skidding	165	119	127	161	0.00
Cable Yarding	0.00	108	100	66	0.00
Helicopter Yarding	90	0.00	0.00	0.00	0.00
TOTAL ACRES	255	227	227	227	0.00

Table IV-5: Harvest Acreage and Harvest Method by Alternative: East Fork Cottonwood Creek

HARVEST METHOD	ALTERNATIVE A	ALTERNATIVE B	ALTERNATIVE C	ALTERNATIVE D	ALTERNATIVE E No Action
Ground-Based Skidding	0.00	0.00	0.00	0.00	0.00
Cable Yarding	0.00	55	55	0.00	0.00
Helicopter Yarding	63	0.00	0.00	0.00	0.00
TOTAL ACRES	63	55	55	0.00	0.00

Alternatives A, B, and C include 58 acres of harvest area utilizing ground-based skidding in the Riley Canyon Creek Watershed.

b. Effects Common to Alternatives A, B and C

The Montana Department of Environmental Quality has identified Blacktail Deer Creek as a water quality limited waterbody. Alternatives A, B, and D include activities in the Cottonwood Creek drainage. Cottonwood Creek is a tributary to Blacktail Deer Creek. The probable causes of impairment listed for Blacktail Deer

Creek in the Montana 305(b) Report include flow alternation, siltation and other habitat alternations. Silviculture and road construction were not identified as probable sources. All activities proposed in Cottonwood Creek will be conducted in accordance with the Montana 75-5.703(10c) MCA by implementing all reasonable land, soil, and water conservation practices (BMPs). The potential for downstream sediment delivery is also reduced by the discontinuous and intermittent nature of lower Cottonwood Creek above its confluence with Blacktail Deer Creek. Siltation or flow alteration of Blacktail Deer Creek is not expected to result from the activities proposed in Cottonwood Creek under these alternatives.

c. Alternative A:

This alternative was developed in response to concerns to reduce the amount of new road construction, and to address concerns of possible impacts of stream crossings on westslope cutthroat trout in the Cottonwood Creek drainage. This alternative would harvest an estimated 2.3 MMBF of timber on approximately 376 acres. The harvest would include 10 harvest units in Sections 11,15,16,20,21, and 22, Township 10 South, Range 08 West, and Sections 33 and 34 Township 10 South, Range 07 West. Conventional yarding would be utilized in five units (2,3,4, and 7) which are well suited for ground based systems. Helicopter yarding would be utilized in seven units (1,5,8,9,10, and 11). Heavier cutting regimes (approximately 70% crown removal) would be utilized in helicopter yarded units.

Under this proposal, an estimated 2.0 miles of new road would be constructed. Approximately 8.8 miles of existing roads would receive minor improvements to the road surface and additional drainage features. In addition, 5.3 miles of existing road would be relocated to avoid steep grades and eliminate drainage and potential sedimentation problems.

Cottonwood Creek Watershed:

Under this alternative, an estimated 600 feet of new road construction would be constructed in the Cottonwood Creek drainage and harvest units would be harvested by helicopter. The road construction is designed to access the helicopter yarding area and would be located on low risk terrain, more than 1500 feet from the stream channel. Consequently, there is low potential for increased sediment production as a result of implementing Alternative A.

Crooked Creek and Divide Creek Watersheds

Access to units within the Long Creek and Riley Canyon watersheds will require improvements and minor relocations of the existing access road located in the Crooked Creek and Divide Creek watersheds. Under Alternative A, an existing undersized culvert on Crooked Creek would be replaced with a new culvert. The reconstructed crossing would be designed to meet BMPs and would be an improvement over the existing crossing.

An existing ford of Divide Creek would be relocated slightly downstream from its present location. The new site will avoid the steep approach grades at the existing ford. Other improvements such as gravel surfacing, additional drainage

features and installation of ford mats will be incorporated into the design of the new ford crossing. Road construction, maintenance, and timber hauling activities would be conducted between July and October 15 of each year that the contract is in effect. This will help insure that use of the ford will occur during a period that the stream channel is most likely to be dry or at low flow. The channel at this location is moderately armored with gravel and cobble size material. Additional protection will be provided by gravel surfacing of the approaches, installation of temporary ford mats and application of erosion control mitigation measures (temporary sediment fence, sediment traps and grass seeding). The anticipated effects of the relocation will be a long-term reduction in delivered fine sediment to Divide Creek at this crossing site compared to sediment levels currently produced at the existing crossing location.

Long Creek Watersheds

The segment of the existing access road located within the Long Creek watershed will also require improvements and minor relocations. An existing drive through ford crossing of Long Creek in Section 29 will be relocated and improved with the installation of a stream crossing structure.

The existing ford has steep approach grades ((~15%) that lack surface drainage features. The road surface is in poor condition and contributes direct sediment delivery to Long Creek. Relocation to a more suitable crossing site will require approximately 0.3 miles of new road construction. The new location will accommodate more acceptable approach grades (0% from southwest and 65 from northeast) and reduce the risk of direct sediment delivery.

The site selected for the relocation of the Long Creek crossing was determined to be unsuitable for the use of a drive through ford for log hauling traffic. This is due to the site being located on a broad and low lying flood prone area which contains fine textured soils with low bearing capacity. Therefore, four other design options were developed: 1) Installation of a standard corrugated metal pipe (culvert); 2) installation of a bottomless structural arch pipe; 3) construction of a permanent bridge; or 4) temporary installation of a portable bridge structure.

Of the four options, Option #1 (standard culvert) poses the greatest risk of long term impacts due to potential failure. A culvert would be vulnerable to plugging and subsequent catastrophic failure due to the presence of an active beaver colony in the immediate vicinity of the crossing site. A standard culvert is also more likely to inhibit sediment transport processes and result in some degree of channel adjustment and modification.

The installation of a bottomless arch pipe (Option #2) would require a higher degree of initial disturbance to the stream channel during installation. Partial excavation of the stream bank and stream bed is required to properly install the footings below stream bed grade. Proper installation of these types of structure takes considerable experience and expertise. In addition, the risk of long term impacts are moderately high because this site is also not well suited to an arch pipe structure. This reach of Long Creek is very sinuous with active lateral

channel migration and grade adjustment (downcutting) occurring. The risk of radical channel migration and meander cutoff is moderately high at this site. Even a slight lateral or vertical channel adjustment could subject the an arch structure to excessive erosion or scour which could cause partial washout of footing and bedding fill or a complete failure of structure itself.

The installation of either a permanent bridge or temporary bridge poses the lowest risk. Either bridge type would be designed with an adequate span that would not constrict the channel and would accommodate the full bankfull width. This would allow for free passage of flood events and normal sediment transport and channel functions. These installations would occur with no disturbance to the active channel or streambank. Of the two types of bridge installations, a temporary bridge would offer the overall risk over the long term. When a temporary bridge is removed the fill material necessary to construct the approaches to the bridge structure could be removed from the flood prone area and the site could be reclaimed and stabilized. A improved ford could be constructed at this site during the bridge removal. This ford would be adequate for the low frequency of recreational and grazing management traffic and use. Future potential channel migrations and adjustments would not be affected.

Drainage features and erosion control mitigation measures would be incorporated under all four crossing design options. Under both bridge options the anticipated effects of the crossing relocation would be a long-term reduction in delivered fine sediment to Long Creek when compared to the sediment levels currently produced at the existing drive through crossing site.

Under this alternative, new road construction and relocation to access Units 1 and 5 in Long Creek will be deferred as these units would be helicopter yarded. When compared to the other action alternatives, this would reduce approximately 1.0 mile of new road construction within the Long creek watershed and eliminate the need for a culvert installation on a new stream crossing of a tributary to Long Creek.

Riley Canyon Watershed

Access to Unit 7 will require will require approximately 1.25 miles of new road construction and 0.70 miles of minor road improvements in the Riley Canyon Creek watershed. This alternative will also require installation and removal of a culvert to construct a temporary stream crossing. All improvement and new road construction will incorporate Best Management Practices to minimize road surface erosion and reduce potential sediment delivery to Riley Canyon Creek at the temporary crossing site.

d. ALTERNATIVE B:

Alternative B would harvest approximately 2.1 million board feet from 340 acres within the Long, Cottonwood, and Riley Canyon watersheds. The harvest would include 7 cutting units located in Sections 11, 15, 16, 21, and 22, Township 10 South, Range 08 West, and Sections 33 and 34 Township 10 South, Range 07

West. Conventional ground based skidding would be used in all but three units (5,8, and a portion of 2) which would require cable yarding.

Under this proposal, approximately 5.5 miles of new road will be constructed. Approximately 8.8 miles of existing roads would receive minor improvements to the road surface and drainage features. In addition, 5.3 miles of existing road would be relocated to avoid steep grades and eliminate chronic drainage problems and potential sediment delivery to stream channels within the analysis area.

Cottonwood Creek Watershed:

Alternative B proposes approximately 3.4 miles of new road construction and 0.7 miles of road improvement within the Cottonwood Creek watershed. New road construction will incorporate all reasonable and applicable soil and water BMPs to limit off-site sediment delivery, soil disturbance, and potential impacts to water quality.

Three crossings of perennial, Class I tributaries to Cottonwood Creek are proposed under Alternative B. These crossings are located in the upper headwaters of the East Fork analysis area. Two crossings through Reach 8 (see stream reach descriptions in Chapter 3) will be temporary and incorporate a steep west approach grade of approximately 15% on shallow, moderately deep, cobbly sandy loam soils. Due to the high erodibility of this soil type, surface drainage features will be difficult to maintain, and the risk of short and long-term sediment delivery to Cottonwood Creek at the crossing site is considered high. The third crossing through Reach 7 (see stream reach descriptions in Chapter 3) poses a lower risk to water quality due to shallow approach grades (~1%) and a well armored channel bottom.

The continuation of the proposed road will traverse steep side slopes exceeding 50% in most locations and have an average surface grade of 8%. Soils are highly erodible, however the potential for long-term failure would be reduced by the planned obliteration and stabilization measures that would be applied after use.

Implementation of Alternative B poses a short and long-term high risk to water quality in the Cottonwood Creek watershed. Westslope cutthroat trout are extremely sensitive to input of fine sediments, particularly regarding the affects of fine sediments on the reproductive stage of the life cycle (MDFWP, internal correspondence).

Divide Creek, Crooked Creek and Long Creek Watersheds

Under this alternative, improvements to the existing access road and crossings of Crooked, Divide Creek and Long Creek would occur as described under Alternative A. The anticipated effects of these improvements will be a long-term reduction in delivered fine sediment to all streams at the crossing sites when compared to sediment levels currently produced at the existing crossing locations.

New road construction to access harvest units # 1-4 in the Long Creek drainage will require the installation of several additional crossing structures. The new road access to Unit 1 will cross a steep draw feature containing an intermittent tributary to Long Creek. The crossing site is located on a moderately unstable stream reach composed of old mass movement depositional features. This crossing will require road construction across steep side slope and construction of a deep fill at the culvert installation. The soil material at this site is moderate to highly erodible and would require a high level of erosion control. This crossing poses a moderately high risk to downstream water quality and fish habitat.

New road construction through Unit 2 will require the installation of several additional culverts to cross several small Class I, and Class II tributaries to Long Creek and several ephemeral draws. Due to steeper channel side slopes and moderate soil erodibility, a 100' Streamside Management Zone will be implemented along Long Creek through portions of Unit 2. Additional equipment restrictions will be used to protect the riparian wetland located on the northwest boundary of Unit 2. All new roads will be constructed and maintained in accordance with all applicable BMPs and season of use restricted to July 1 - October 15.

RILEY CANYON WATERSHED

Access to unit #7 located in the Riley Canyon Creek watersheds will require approximately 1.25 miles of new road construction and .70 miles of minor road improvements. All improvement and new road construction will incorporate Best Management Practices to minimize road surface erosion and reduce potential sediment delivery to streams at crossing sites.

e. ALTERNATIVE C:

Alternative C would harvest an estimated 1.7 mmbf of timber on 283 acres. The harvest would include six harvest units located in Sections 15, 16, 21, and 22, Township 10 South, Range 08 West, and Sections 33 and 34 Township 10 South, Range 07 West. No harvesting would occur in Section 11 in the Riley Canyon watershed. Conventional ground skidding would be used in all but three units (5,8, and a portion of 2) which would be cable yarded.

Under this proposal, approximately 4.1 miles of new road will be constructed. Approximately 8.0 miles of existing roads would receive minor improvements to the road surface and drainage features. In addition, 3.8 miles of existing road would be relocated to avoid steep grades and eliminate chronic drainage problems and potential sediment delivery to stream channels within the analysis area.

Crooked Creek, Divide Creek and Long Creek Watersheds

Under this alternative, the effects of the proposed activities on sediment

production are consistent with those described under Alternative B (see above). Road improvement, road relocation and new construction activities are identical to Alternative B, and will include improvements to the existing crossings of Crooked, Divide and Long Creeks, resulting in improved water quality and fish habitat at these sites.

Riley Canyon Watersheds

No timber harvest, road construction, or road improvement activities would occur in the Riley Canyon watershed under Alternative C. Existing levels of sediment production would be maintained and there would be no effect to water quality under this alternative.

Cottonwood Creek Watershed

Alternative C proposes approximately 3.4 miles of new road construction and 0.7 miles of road improvement within the Cottonwood Creek watershed. New road construction will incorporate all reasonable and applicable soil and water BMPs to limit off-site sediment delivery, soil disturbance, and potential impacts to water quality. Under this alternative, the effects of the proposed activities on sediment production are consistent with those described under Alternative B (see above). Road improvement, road relocation and new construction activities are identical to Alternative B, and would include three designated crossings of Cottonwood Creek that pose a moderate-high risk to water quality and westslope cutthroat trout habitat. Due to approach grades, steepness of adjacent side slopes and soil types, the proposed road activities pose a high risk of increasing sediment delivery to the Cottonwood Creek drainage.

f. ALTERNATIVE D:

In response to concerns regarding possible impacts to Upper Missouri westslope cutthroat trout in Cottonwood Creek, this alternative was developed in which no harvesting or road construction would occur in this drainage. Under this alternative, the harvest would include 6 cutting units located in Sections 11,15,16,21, and 22, Township 10 South, Range 08 West. No harvest would occur in Sections 33 and 34 Township 10 South, Range 07 West. Approximately 1.4 MMBF of timber would be harvested from 285 acres. Conventional ground skidding would be used in all but two units (5 and portion of 2) which would be cable yarded.

Under this alternative 3.8 miles of new road would be constructed and approximately 8.0 miles of existing roads would receive minor improvements to the road surface and drainage features. In addition, 4.2 miles of existing road would be relocated to avoid steep grades and eliminate drainage and possible sedimentation problems.

Crooked Creek, Divide Creek and Long Creek Watersheds

Under this alternative, the effects of the proposed activities on sediment production are consistent with those disclosed under Alternative B (see above).

Road improvement, road relocation and new construction activities are identical to Alternative B, and will include improvements to the existing crossings of Crooked, Divide and Long Creeks, resulting in improved water quality and fish habitat at these sites.

Riley Canyon Watersheds

Under this alternative, the effects of the proposed activities on sediment production are consistent with those disclosed for Alternative B (see above). Access to Riley Canyon watershed will require approximately 1.25 miles of new road construction and 0.70 miles of minor road improvements. All improvement and new road construction will incorporate Best Management Practices to minimize road surface erosion and reduce potential sediment delivery to streams at crossing sites.

Cottonwood Creek Watershed

Under this alternative, timber harvest activities, road construction and proposed stream crossings would be deferred in the Cottonwood Creek drainage to address potential impacts to water quality and westslope cutthroat trout habitat. Sediment production and routing to Cottonwood Creek would not be affected through implementation of Alternative D. Therefore, water Quality and fisheries habitat would not be affected by this alternative.

g. ALTERNATIVE E: NO ACTION

No timber harvest, road construction, or road improvement activities would be conducted under the "No Action" alternative. Licensed grazing and recreational activities would continue. No timber revenue would be generated and the site would not be reevaluated for timber harvest for another 10-20 years. Existing sediment sources identified in Chapter 3 would continue to deliver sediment to channels within the analysis area.

4. Fish Passage

Concerns raised by DFWP fisheries biologist regarding the proposed activities in Long Creek and Divide Creek watersheds included improper installation and or lack of maintenance of a culverts which could result in the creation of a barrier to fish movement and biologically fragment the population. In response to this concern, all action alternatives include improvements to the existing stream crossings that address both existing water quality impacts and fish passage.

The relocated crossing of Divide Creek would utilize an improved ford design. This design incorporates gravel surfacing of crossing approaches and the installation of temporary ford mats during log hauling operations. This design was favored over the construction of a permanent crossing structure by both DFWP fish biologist and DNRC hydrologist for reducing potential for sediment impacts while providing adequate fish passage.

The site selected for the relocation of the existing Long Creek ford crossing was determined to be unsuitable for use of a ford for log hauling traffic. Therefore four structural stream crossing options

were developed for the design: 1) Installation of a standard corrugated metal pipe); 2) Installation of a bottomless arch pipe; 3) Construction of a permanent bridge; and, 4) temporary installation of a portable bridge structure. Option #1 (standard culvert) would pose a greater risk to biological disconnectivity as a closed pipe would be more likely to inhibit sediment transport processes and result in some degree of channel modification. Option #2 (bottomless arch) would promote sediment transport as the channel bottom would remain connected and not result in accelerated stream velocities. However, a bottomless arch would be vulnerable to lateral channel migration and vertical grade adjustment associated with this reach of stream channel. Option #3 (bridge) and Option #4 (temporary bridge) would pose the least risk to fish passage and biological disconnectivity. Both bridge designs would utilize a span that would allow for construction and maintenance of crossing with no disturbance to the stream channel.

There are no additional stream crossings proposed for the fish bearing streams in the Long Creek or Divide Creek watersheds.

IV. SOILS AND GEOLOGY:

A. ENVIRONMENTAL EFFECTS ON SOILS & MITIGATION MEASURES.

Primary soil concerns are potential displacement associated with soil disturbance during road construction, harvest operations and site preparation. Potential site impacts are difficulty with regeneration, reduced site productivity and increased runoff and erosion. Susceptibility to impact varies with soil type, harvest method, type of equipment and season of use. Most sensitive soils are wet sites and steep slopes that will be avoided or protected through implementation of BMP'S and site-specific mitigation measures of DNRC Soil Scientist and Hydrologist.

Helicopter and cable harvest of timber would have negligible effects on soil productivity and erosivity, assuming that slash will be left on site for nutrient cycling. Landings for helicopters would be larger than those typically used for ground based yarding, but landings would be more widely spaced than conventional yarding methods. All landings would be located on moderate sloping, well-drained sites.

Ground-based skidding with rubber-tired skidders, tractors, or clippers are the most economical methods of timber harvest on well-drained soils of moderate slope. Skidders and tractors have a higher risk of affecting soils through displacement, compaction, and area of disturbance. Main skid trails can become compacted and reduce the long-term productivity of the site. The area and degree of soil impacts can be mitigated by skid trail planning, avoiding operations when wet and installing erosion control features where needed.

Slash disposal would be accomplished by lop and scatter of slash and spot piling of slash at landings to reduce the area of soil impacts. Woody debris would be retained at 10 to 20 tons/acre to promote long-term soil stability and productivity. Ground disturbance associated with harvest should be adequate to reestablish mixed stands of Douglas fir and lodgepole pine.

Table IV-6 Summary of Timber Harvest Effects on Soil Resources

Alternative	Acres of Harvest	Helicopter/Cable harvest acres	Acres of Tractor harvest	Estimated Maximum acres of Harvest effects *
A	376	210 (56%)	165 (44%)	24.7
B	340	163 (48%)	177 (52%)	26.5
C	282	156 (55%)	127 (45%)	19.0
D	285	66 (33%)	219 (77%)	32.8
E	0	0	0	0

*** Assumes 15 % of area affected by skid trails and disturbance.**

For all action alternatives, general mitigation measures (see Chapter 2) and BMP's would be implemented to minimize the area and degree of soil effects associated with proposed harvest and road construction. A complete detailed site-specific review for mitigation measures or designation as leave areas will be completed prior to contract development.

All action alternatives will implement highest level of site specific mitigation to roads and harvest areas to reduce risk of slope instability.

Road drainage will be installed concurrent with construction and will be maintained. If cutslope or fillslope slumps occur, they will be stabilized within the course of the harvest project to control erosion.

On localized areas of marginal slope stability, all sweeping and large diameter trees that may instigate slope stability if blown down or toppled over as a course of mortality will be removed, and retention trees will be left on an even spacing of roughly 30 ft. apart with preference for younger age classes (codominants) that are expected to be actively growing, more windfirm and continue evapotranspiration of subsoil water. No even age management would be implemented directly above or adjacent to identified instability areas.

1. Alternative A.

This alternative would construct approximately 2 miles of new road. New road construction through forested sites could reduce forest soil productivity and convert these sites to mainly grass, but would have little effect on range sites. Reconstruction would improve drainage on 8.8 miles of existing roads. This alternative would not construct road access into unit 8 of section 33 & 34.

Timber harvest of Units 1,5,8,9,10,11 & 12 would be completed by helicopter, which would cover more area than other alternatives, yet have negligible ground disturbing effects on soils and low risk of erosion. Tractor harvest units (2,3,4, & 7) would likely incur similar ground effects as the other action alternatives on a proportional basis but would involve fewer acres than alternatives B and D.

2. Alternative B.

This alternative would construct about 5.5 miles of road. New road construction thru forested sites could reduce forest soil productivity and convert these sites to mainly grass, but would have little effect on range sites. About 5.7 miles of existing road would be relocated to replace roads on steep grades, poor locations and creek fords that are eroding and possible sediment sources. Minor reconstruction would improve drainage on 8.8 miles of existing roads and reduce current erosion. Abandoned roads and temporary use road would be stabilized and revegetated to control erosion and restore some grassland productivity. This alternative would construct an access road to unit 8 by crossing segments of steep sideslopes and involve two creek crossings. Road construction on segments of steep sideslopes present a moderate to high risk of erosion that will require above average erosion control for revegetation and to limit sedimentation.

Timber harvest of Units 1, 3, 4,7, and a portion of unit 2 would be completed by conventional tractor skidding. Tractor skidding will be limited to acceptable slopes. Limiting skidding equipment to slopes less than 40% and limiting dozer piling to slopes less than 35% can control soil displacement. Alternatives B and D have a

higher percentage of conventional tractor skidding than alternatives A and C. Cable harvest of proposed units 5, 8 and a portion of 2 would have negligible ground disturbing effects on soils and presents low risk of erosion.

3. **Alternative C.**

This alternative would construct about 2 miles of road. New road construction through forested sites would reduce forest soil productivity and convert these sites to mainly grass, but would have little effect on range sites. Reconstruction would improve drainage on 8.8 miles of existing roads and reduce erosion. This alternative would not include road reconstruction and new construction to portions of section 11 and the associated harvest and effects on about 58 acres. This alternative would construct an access road to unit 8 by crossing segments of steep sideslopes and involve two creek crossings that require above average erosion control for revegetation and to limit sedimentation.

Timber harvest of units 1, 3, 4, and a portion of unit 2 units would be completed by conventional tractor skidding, with cable harvest on steeper slopes of units 2, 5, & 8 with similar effects as the other action alternatives. Tractor harvest units would likely incur similar ground effects as Alt. B on a proportional basis.

4. **Alternative D.**

This alternative would construct about 3.8 miles of road. New road construction through forested sites could reduce forest soil productivity and convert these sites to mainly grass, but would have little effect on range sites. About 4.2 miles of existing road would be relocated to replace roads on steep grades, poor locations and creek fords that are eroding and possible sediment sources. Minor reconstruction would improve drainage on 8.0 miles of existing roads and reduce current erosion. Abandoned roads and temporary use roads would be stabilized and revegetated to control erosion and restore some grassland productivity. No harvest or associated road construction would occur in the Cottonwood Creek drainage.

Timber harvest of Units 1, 3, 4,7, and a portion of unit 2 would be completed by conventional tractor skidding. Tractor skidding will be limited to acceptable slopes. Soil displacement can be controlled by limiting skidding equipment to slopes less than 40% and limiting dozer piling to slopes less than 35%. Cable harvest of proposed units 5 and a portion of 2 would have negligible ground disturbing effects on soils and presents low risk of erosion.

5. **Cumulative effects to soil productivity.**

Cumulative effects can occur from repeated ground-based entries into a harvest area. There are several old skid trails from the distant past present in Section 15 that would be utilized in all action alternatives. All Action alternatives would control the area of soil effects associated with timber harvest by skid trail planning and minimizing disturbance to that needed for silvicultural goals as noted in the

mitigation measures. Temporary roads would be stabilized and revegetated. Any future harvest would likely use the same road system and skid trail planning and therefore present low risk of cumulative effects. Large woody debris will be retained for nutrient cycling and long term productivity and therefore presents low risk of cumulative effects to soil productivity.

V. WILDLIFE:

Cumulative impacts were considered as part of this analysis. Two nested landscape analysis areas have been delineated for the Long/Cotton Timber Sale based on the area utilized by the predominant elk herd and land ownership. The Large Analysis Area (Figure III - 2) encompasses 87,945 ac. And is defined by the polygon connecting the outermost yearlong distribution of radio telemetry locations from the Blacktail Ridge herd [map of polygon from Ken Hamlin, Montana Department of Fish Wildlife and Parks (MDFWP)]. It was used primarily for analysis of the coarse filter landscape parameters and influences on elk. The more-immediate analysis area is the Project Area (Figure III – 3) and consists of the state ownership in the vicinity of the proposed timber sale and intermingled ownership, for a total of 20,371 ac. within this smaller, but substantial polygon. It was used in the analyses of influences on all species considered. The existing landscape is considered to be a reflection of past management activities, so analyses of existing conditions include the effects of these activities. Classification of forest/non-forest in a geographical information system (GIS) based on 1996 Landsat imagery suggests little, if any, timber harvest in the Large Analysis Area. This is further substantiated by the classification of most of the BLM land as Roadless Area or Wilderness Study Area. Future impacts were incorporated by discussing planned future changes to the landscape in those two analysis areas.

A. Coarse Filter: Habitat Elements Supporting Biological Diversity

This section is devoted to an examination of how project alternatives may affect biological diversity in very broad terms through their influence on landscape patterns and processes. This broad approach follows the coarse filter concept discussed in Chapter III. This section is followed by another section (B) that examines project alternatives in terms of their influence on individual species that are of special concern or interest (fine filter).

1. Landscape Characteristics

Landscape characteristics include such attributes as habitat fragmentation, patch size and shape, and connectivity of habitats. Some of this configuration can be characterized with indices, however, measurement of many of these characteristics is in its infancy. Many indices have been developed in recent years, but how they correlate biologically has not been documented well. Their main utility is in their provision of a relative index for comparisons of landscape configurations.

Landscape indices were calculated on the existing condition in a rather coarse manner because there is no existing stand-level inventory available for GIS analysis of patch characteristics. GIS database information is only available for forest versus nonforest, and since none of

the stands would be converted to grassland/shrubland, the patch configurations would not change under such a coarse analysis.

a) No Action Alternative

Under the No Action Alternative, general landscape characteristics would remain unchanged for the near future. Gradual encroachment of forested patches into grassland would probably continue as long as fire suppression remains DNRC policy. In the very long term, there would be more forest than would naturally occur. This alternative slightly favors those species associated with forest. Patches would continue to be slightly larger, more numerous, and a little better connected than turn-of-the-century conditions.

b) Action Alternatives

None of the Action Alternatives change the characteristics of the landscape fundamentally. Forest patches would remain forested, albeit with reduced stocking. Forest interior conditions, currently limited in the Project Area, would remain limited. The forest interior condition occurs in that part of a forest stand that is far enough from a forest edge that it is not influenced as significantly by some factors associated with forest edges, such as the drying elements of wind and insolation, by the wider fluctuations of temperatures, or by edge-associated flora and fauna. The forest interior condition would be lost in the areas now having it that are in Units 8 and 9 for Alternatives A, B and C, and in the 46-acre lodgepole stand within Unit 3 for all Alternatives because of the seedtree-like cutting in these areas. Interior conditions would be compromised to some degree within areas receiving other treatments. In summary, interior forest wildlife, such as the red-breasted nuthatch, are likely to lose 46 acres of habitat, and may lose to some degree, up to 212 other acres of habitat. The amount depends on what proportion of the acreage is currently providing interior conditions, and to what degree the treatments detract from interior-dependent wildlife use. These thresholds have not been defined in the scientific literature.

Forest/grassland edge, currently common in the Project Area, is not likely to change. One area where edge may increase is in the area of removed lodgepole in Unit 3. This stand's abutment with thicker remnants of forest after treatment could detract from interior conditions in the thicker forest, and could attract edge-associated wildlife due to the contrast of more open conditions with thicker forest. A buffer that would be left around the outside edge of Unit 3, screening any interior edges minimizes this likelihood. The large Douglas fir remaining in the lodgepole area would also add a more forested condition than the density of stems might suggest.

Figure - IV-1
PROJECT AREA INDICATING HARVEST UNIT NUMBERS

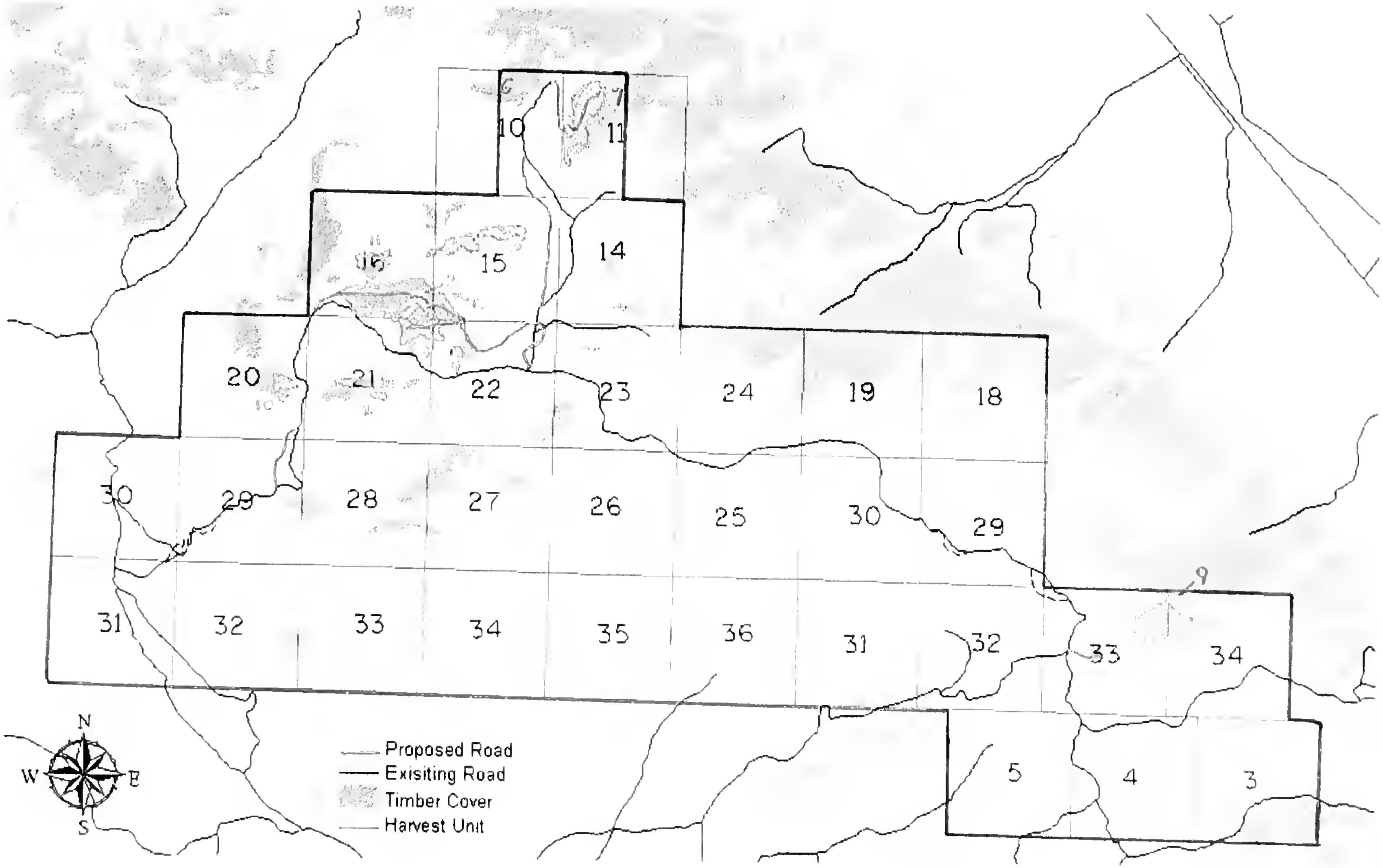
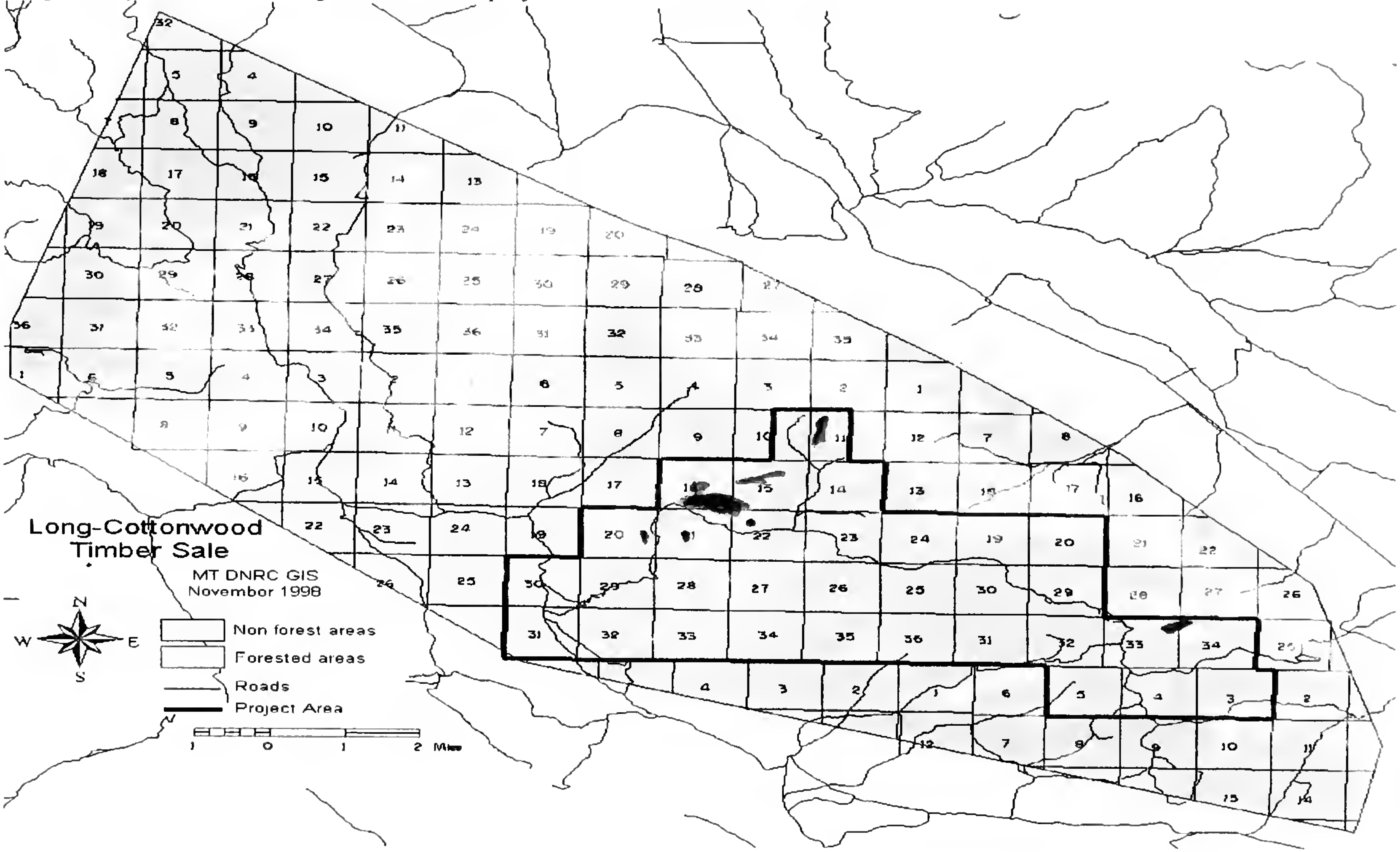


Figure IV-2
Large Analysis Area Showing Forest Cover, project Area and Alternative A Harvest Units



2. Forest Types, Successional Stages, and Fire History:

a. Forest Types

The No Action alternative would result in no appreciable change in forest types in the near term. This alternative slightly favors those wildlife species associated with forest, especially forest with shade-tolerant tree species.

None of the Action Alternatives would produce fundamental changes in classifications of forest types except in one area-- in the lodgepole pine of Unit 3, where all alternatives call for removing lodgepole and leaving the large, old, scattered Douglas fir. Wildlife associated with lodgepole pine may likely decrease and wildlife associated with Douglas fir could likely increase.

b. Successional Stages

The No Action Alternative would result in continued succession unless fire intervened to move succession back to the seedling stage. Little change would be expected within stands currently categorized as old growth in terms of habitat or associated wildlife.

All action alternatives would maintain far more than half of the acreage of old growth that would be expected to occur under historical, natural conditions, and would therefore meet the standards set forth in the SFLMP. Although estimates exist in the literature on the minimum number of snags necessary to meet snag dependent species, we know of no research that indicates the minimum number of old trees necessary for a stand to meet the needs of all old-growth associated wildlife. The best indications are that old growth stands other than those in Units 8 and 9 should continue to function as old growth since they would maintain most of their old growth attributes and would more nearly resemble old growth at the turn of the century. Old growth qualities would be greatly diminished in Units 8 and 9. These qualities would be reduced in other old growth to the degree that large tree boles and large snags were removed, but planned mitigation common to all alternatives provides for retention of these.

Approximately 800 acres of other unlogged old growth within the Project Area would provide habitat to some degree for old-growth associated wildlife. One previously proposed unit (#6) was dropped from consideration for this sale due in part to its old-growth qualities.

All action Alternatives result in a reduction in the probability that any naturally-occurring fires would become large conflagrations, because all reduce the quantity of understory ladder fuels. Such reductions are probably proportional to the acreage treated in each Action Alternative.

3. Old Growth Attributes

a. Snags

The No Action alternative would have little immediate impact on the number and characteristics of snags. Snag abundance is likely to gradually increase as stands become more decadent.

Under any of the Action Alternatives, existing snags would be protected wherever possible. Some loss of snags would likely occur incidentally to timber harvesting operations. Fewer trees would remain to eventually die and become snags, thus snag abundance would be reduced relative to the No Action Alternative. Snag abundance post-harvest would also be considerably less than would result immediately from a natural fire, in which many trees become snags. It is less clear how the abundance of snags post-harvest would compare with the long-term trend in snags, post-fire. Fires tend to produce a flush of snags, but many of them do not survive long, and few large, mature trees exist to replace them after they have fallen. In contrast, timber harvest such as envisioned under any of the Action Alternatives would protect a few (existing) snags over the short-run, but retain a greater number of live trees for long-term snag recruitment than would a fire.

b. Large Woody Debris

We would expect the pattern of large woody debris to generally follow that described above for snags under all No Action and Action Alternatives. Within areas harvested, specifications call for no less than 20 tons/acre of slash and woody debris to be retained. These amounts of residual large woody debris are generally in accord with recommendations made by Graham et al. (1994) for these habitat types to maintain forest productivity.

4. Special Elements

a. Riparian Zones

Riparian zones are currently not well forested in the Project Area. Influences are more closely related to livestock grazing practices than to timber harvesting. No harvesting is planned within the SMZ's. Thus, it is unlikely that any of the Alternatives, including the No Action Alternative, would, of themselves, be capable of affecting riparian conditions in the Project Area.

b. Rare Habitat Features

Because there are no bogs, fens, potholes, or particularly rare forest types within the project area, these are not considered further.

B. Fine Filter: Selected Species Considered Individually

1. Species Listed under the Endangered Species Act

a. Peregrine Falcon (*Falco peregrinus*)

Peregrine falcons have not been documented from the vicinity of the Project Area. Because the nearest nests are at least 10 miles distant, we do not expect substantial use of the project area by peregrines. None of the Alternatives are expected to impact peregrine falcon activity. Consequently, no special stipulations should be required for peregrines under any Action Alternative. We expect no cumulative effects on peregrine falcons arising from future and/or nearby actions.

b. Wolf (*Canis lupus*)

The primary needs of wolves are i) adequate prey resources, ii) seclusion during denning and pup-rearing periods, and iii) tolerably low probability of direct mortality from humans. These are treated in turn, below.

None of the Alternatives are expected to have substantial influences on prey availability or distribution. Temporal distribution of elk during autumn may be modified slightly by removal of cover in Units 8 and 9 in Alternatives A, B, and C.

Human use of the project area during denning and pup-rearing periods is currently low; thus the No Action alternative would likely cause no loss of seclusion. Effective closure of roads to motorized vehicles would result in a similarly low human use of the area under each of the action Alternatives. In no case would road building/timber harvest activities be expected to affect wolf denning, because wolves generally leave their den sites before June 1, and the earliest date of entry for timber harvest and road construction is July 1. Action Alternatives also include mitigation measures that would defer road building/harvest within a 1-mi radius of any active den or rendezvous sites discovered, until such time as wolves using these sites have moved on. Thus, seclusion during denning and pup-rearing periods would not be compromised under any of the Alternatives.

The probability of direct mortality from humans is, once again, best approximated by the density of humans on the area, for which road densities provide the best surrogate measure. By minimizing the potential increase in road density through post-harvest road closures, we expect road density within the Project Area to remain similar, but with increasing numbers of hunters on those roads during the early part of hunting season. Snow typically seals off access by vehicle from the east sometime during the general big game hunting season, until a point is reached when there is enough continuous snow cover for snowmobiles. The probability of human-caused wolf mortality on the area as measured by road density will remain virtually the same after logging

Because we project that wolf occupancy of the project area would not be precluded or made substantially less likely under any of the Alternatives, we similarly project that the area's potential to act as a linkage between the recently

established populations in the Yellowstone and central Idaho areas would not be compromised under any Alternative. Further, as Mladenoff et al. (1995) pointed out, "...a simple island/corridor habitat model applies poorly to the wolf, a species with low habitat affinity. Wolves readily move through a variable complex of habitat favorability...favorable areas are found and rapid population growth is therefore possible even in fragmented landscapes, as long as the source population remains high and a constant source of colonizers is available".

1) Road Density

Table IV-7 summarizes miles of open road and open road density projected to exist following completion of the project under the various Alternatives. Open roads are those open to vehicle travel by the public. The same general pattern emerges in each Action Alternative where there would be slightly more open road after completion of all alternatives. There are .90 mi/mi^2 of existing open roads on the Project Area and this would continue under the No Action Alternative.

Under all action Alternatives, open road density (and therefore, wolf vulnerability) would increase slightly from the current .90 to a post-harvest density of .94 or .95 mi/mi^2. Much of the new road and all road replaced by relocation would be closed with physical barriers to make them impassable by motorized vehicles. Slash would be spread on roads to discourage foot traffic. Much of the area is accessible by off-road driving across the extensive grassland, especially on ridgetops, and this won't change.

Table IV-7: Road densities for the Large Analysis Area and Project Area before and after each Alternative.

ALTERNATIVE	PROJECT AREA ROADS				LARGE ANALYSIS AREA ROADS			
	Miles		Density (mi/mi^2)		Miles		Density (mi/mi^2)	
	Before	After	Before	After	Before	After	Before	After
No Action (Existing Condition)	28.7	28.7	.90	.90	114.1	114.1	.83	.83
A	28.7	30.2	.90	.95	114.1	115.4	.83	.84
B	28.7	30.2	.90	.95	114.1	115.4	.83	.84
C	28.7	30.2	.90	.95	114.1	115.4	.83	.84
D	28.7	29.9	.90	.94	114.1	115.3	.83	.84

2) Prey Base

The area's elk population is not likely to change meaningfully as a prey base under No Action or Action Alternatives until influenced by severe weather shifts, changes in hunter numbers, or hunting regulation changes. After all Action Alternatives, bull elk in the Project Area may be slightly more vulnerable to hunters and cow harvest is regulated by permit.

3) Use by Wolves

Since open road density and prey populations would not change much, if any, under No Action or Action Alternatives, wolf use would not be discouraged. Wolves would not be displaced by active operations during the critical denning period, because the operating season begins afterwards on July 1 of each year.

Cumulative Effects on wolves

Because we do not anticipate substantial increase in human access to either the Project Area or adjacent BLM lands due to this project, we do not expect cumulative impacts on wolves.

2. Sensitive Species on MDNRC Central Land Office Lands

a. Ferruginous Hawk (*Buteo regalis*)

Ferruginous hawks in the Centennial Valley nest primarily in willows at lower elevations (Restani 1991). Such conditions typify only the southernmost portions of the State-owned tract in the Blacktails, and no road building or timber harvesting is planned within a few miles of these habitats. Thus, it seems unlikely that any of the proposed Alternatives or cumulative effects from state, private, or federal projects within the project area would have a direct effect on ferruginous hawks.

b. Boreal Owl (*Aegolius funereus*)

Within the project area, several stands (all of, or parts of, all Units except 9, 10, and 11) appear to provide appropriate habitat for boreal owls. Under the No Action Alternative, these stands would remain unchanged unless influenced by fire. Snags for nesting are relatively abundant, but some areas have dense regeneration in the understory that limits foraging success, such as some of the eastern parts of Units 2 and 3. Unit 7 is especially attractive.

Under all four Action Alternatives, spruce/fir stands with these characteristics would retain a large proportion of their attributes that are attractive to boreal owls. Some large trees would be removed that would reduce the potential for future recruitment of large snags. In the short term, the forest floor would be more open after logging, facilitating capture of small mammals. As regeneration becomes established in the understory, hunting opportunities would be more limited in those areas with thick regeneration. Unit 7 would be harvested by group selection under Alternatives A, B, and D. Those small cut patches would produce thick regeneration in the future, while 75% of the stand would continue to provide good foraging. In summary, nesting habitat would be ample after all alternatives, foraging habitat structure would be more plentiful in the short term, and foraging habitat structure would be somewhat less abundant in the longer term. The response of small mammal prey to habitat changes such as these are not well understood (Hayward 1994).

Since logging in the analysis areas on private land has been and will be in non-boreal owl habitat and BLM harvest has apparently been almost non-existent, no cumulative effects are anticipated.

c. Black-backed Woodpecker (*Picoides arcticus*)

The No Action Alternative would provide a continuation of the moderately high probability of a crown fire in the future, which would benefit black-backed woodpeckers. Until a fire occurs, the habitat would remain low in value.

It is unclear whether timber harvesting contemplated under Action Alternatives would negatively affect black-backed woodpeckers. There are no recent burns in the Project area that provide optimal habitat for black-backed woodpeckers, although some relatively minor, foraging use may occur. In general, reduction of tree density, particularly trees vulnerable to beetle-attack, would be expected to reduce habitat quality; however, black-backed woodpeckers frequently use open-canopied stands for foraging. More certain is that a reduction in the probability of future fires constitutes an indirect negative impact on black-backed woodpeckers, because they appear to be tied to flushes in their preferred insect prey that are associated with recent burns. Thus, Action Alternatives that reduce the probability of a crown fire would have a minor and indirect negative impact on black-backed woodpeckers.

Fire exclusion and a small logging job on adjacent private grounds is expected to have a similar cumulative effect, except removal of snags may be more severe there.

d. Townsend's Big-Eared Bat (*Plecotus townsendii*)

The No Action Alternative would have no measurable effect on the big-eared bat.Townsend's big-eared bats are very susceptible to disturbance and may permanently abandon hibernating sites and roosts if disturbed. Mitigation measures to defer activities near any such sites discovered would avoid disturbance under all Action Alternaives. However, it is doubtful that any such concentration sites exist within the project area. Because Townsend's big-eared

bats occasionally use large snags for roosting, any removal of large-sized, hollow snags could slightly decrease habitat quality for Townsend's big-eared bats if roosting habitat is limited. Silvicultural prescriptions would emphasize retention of existing snags, thus minimizing this reduction. Logging planned on adjacent private ground is likely to remove snags and have a slight but additive negative effect.

e. Pileated Woodpecker (*Dryocopus pileatus*)

The No Action Alternative would provide for a continuation of the existing good conditions for the pileated woodpecker over most of the area for the foreseeable future.

Since the pileated woodpecker is a large bird that needs large snags and large woody debris, Action Alternatives would reduce habitat quality to the extent that these components are reduced below their saturation point. The saturation point is that density of attributes that when exceeded, provides more than the birds can utilize. Since research has not defined a saturation point for snags and LWD for the pileated, it is safest to assume that any reduction is negative.

All Action Alternatives are mitigated by MDNRC's planned preservation of large, old trees, snags, and LWD. Some snags would be lost during harvest operations, and the potential for future recruitment of large snags would be greatly diminished in Units 8 and 9 that would receive Treatment 1 under Alternatives A, B, and/or C. This treatment resembles a seedtree harvest. Logging planned on adjacent private ground is likely to remove snags and have a slight but additive negative effect.

f. Cumulative Impacts on Sensitive Species

Human access within the Project Area and adjacent BLM and small-private lands is increasing slightly. This project should not contribute to increased access as far as increased numbers of people, but only in the sense of a slightly higher density of open roads (increase of .04-.05 mi/mi^2). A small acreage (20ac) is planned for timber harvest on neighboring small-private ownership. This would slightly reduce the acreage available to those species dependent on old-growth attributes, assuming this acreage has these attributes. Past harvest in surrounding areas has only totaled about 4% of the forest. Cumulative effects risks appear to be very low.

3. Game Species: Elk

As noted in Chapter III, the primary concerns with elk management revolve around habitat and hunting. Cumulative effects on elk are not only examined for the two analysis areas described on page 86 in the introduction to the wildlife section, but also for the DNRC forest management program within the Gravelly/Snowcrest Elk Management Unit. The primary concern of the analysis is the primary elk herd utilizing the Project Area, the Blacktail Ridge Herd that winters along the north face of these mountains and then disperses into the Project Area and Large Analysis

Area for the rest of the year. Although it is possible that individual elk or small groups from other herds may intermingle in the Project Area, it is this herd that will primarily experience the positive and negative effects of land management here.

a. Elk Habitat

Under the No Action and Action Alternatives, there would be no effect on the generally recognized winter range. Elk tend to winter at lower elevations north of the Project Area. However, Jim Roscoe (BLM biologist, pers. comm.) noted evidence of some bulls wintering high in Cottonwood Creek, perhaps as high as Units 8 and 9. Whether use occurs quite this high in severe winters is not known.

Under the No Action and Action Alternatives, there would be no likely effect on calving grounds during operations or in the future since the logging season starts after calving each year and elk in this area calve in open areas relatively unaffected by these alternatives.

Action Alternative A requires helicopters to yard logs from harvest units to landing areas. Helicopter (as well as other logging) activity can disturb elk (Olson 1981) and is likely to displace elk during the logging season of July 1 - October 15. All harvest activities would be excluded from the General Big Game Season, which would allow elk to utilize cover in this area during the life of the contract.

b. Elk Security in and near the Project Area

The effects of the alternatives on elk security [and bull elk vulnerability, discussed in section c.1) below] are more difficult to quantify in these more open landscapes, especially near the ridgetops because of the possibilities for cross-country driving. Since roads are not the only possible source of access within the area, they may provide somewhat less of a precise measure of access influences. Recreationists are constrained to roads by regulation on public land here, but the public's compliance with these constraints varies by region. This section of the analysis focuses on elk security outside of hunting season and relates to how effectively elk may use their habitat without displacement.

For the No Action Alternative, elk habitat effectiveness would not likely change much. Access is increasing slightly as explained on page 60, but outside of hunting season, number of visitors should remain light.

For the Action Alternatives, the greatest influence would come from the loss of cover in Units 8 and/or 9 in Alternatives A, B and C and in the part of Unit 3 where lodgepole will be removed in all Action Alternatives. Although this only amounts to 55-63ac in Units 8 and 9 and 46ac in part of Unit 3, cover is limited in this open landscape. Selective logging in other parts of Unit 3 and in all other units (1-5 and 7) under all Action Alternatives is likely to preserve much of the cover value. The road that would be established through the block of cover provided by Units 2 and 3 would temporarily replace a steep road outside the unit. Roads in all units will be physically closed and slash scattered on them to discourage foot traffic. The steep road outside these units will be retained to preserve the primitive character of the area. The overall effect of roads is not likely to change much since open

road density would only change .04-. 05 mi/mi^2 for all Action Alternatives and would remain below 1 mi/mi^2.

A Unit 6 that was formerly proposed for inclusion in sale alternatives was dropped completely, due in part to the high level of elk use.

c. Hunting Objectives

1) Bull Elk Vulnerability

Hillis et al. (1991) emphasized the role of security areas in holding elk in an area during hunting season and in reducing their vulnerability to hunting mortality. An analysis of security cover fitting the Hillis Paradigm (forest cover blocks .5mi or farther from roads and 250ac or larger in size) indicated that six stands fit the criteria in the Large Analysis Area and no stands fit the criteria in the Project Area. The Large Analysis Area has 12.4% of its area in security cover and the Project Area has 0%. After the forested areas within .5mi of roads were excluded from consideration for Hillis security areas in the Project Area, the largest patch of cover left was 83 acres. There were 28 smaller patches of cover.

Under the No Action Alternative, no change in bull elk vulnerability is anticipated on state ownership from a habitat standpoint. The small, discontinuous patches of forest in the Project Area would continue to provide limited cover. While cover in Units 7, 8, and 9 would not offer security cover in themselves, they are contiguous with stands outside of the Analysis Areas that do. Since the establishment of leased access across private land between Wood's Canyon and the Project Area and better access via BLM road west of the Project Area in the Larger Analysis Area, hunter numbers are likely to increase to some unknown extent in both analysis areas. It is clear that elk security can't be provided by vegetation alone with the existing small patches, however. If hunter numbers increase, further vehicle access limitations or hunting regulations limiting numbers of hunters or effectiveness of hunters may need to be imposed by MDFWP to spread bull harvest through the season and provide older bulls.

The Action Alternatives would not reduce the availability of blocks of cover fitting the Hillis Paradigm. This is not to imply that forest cover in the Project Area is expendable as far as elk vulnerability is concerned. Only 9.8% of the Project Area and 25.0% of the Large Analysis Area provide forested cover, and any loss of cover could make some difference. Under Alternative D, forest in units would be thinner, but all areas would essentially remain forested except the 46ac lodgepole pine portion of Unit 3. Alternatives A, B, and C would result in a loss of 101-109ac of cover in part of Unit3, Units 8 and/or 9 from seedtree-like prescriptions. This amounts to 5.4% of the existing forest in the Project Area, dropping forest cover slightly to 9.3% of the Project Area. Forested cover in the Large Analysis Area would drop slightly to 24.5% of the area, or a loss of 0.5% of the forested acreage. Since elk are less sensitive to the specific nature of coniferous cover during

hunting season (Lyon and Canfield 1991), selective logging in other units is likely to preserve a large degree of their cover value under all Alternatives. Hunter access due to road density would not increase noticeably after any Action Alternatives when the open road density increases by .04-.05 mi/mi^2.

In summary of the above effects, an elk hunter searching in timber in the vicinity of the proposed sale in its current condition will push elk completely out of any of these timber stands in one or two passes. These stands provide poor security for elk. Similarly, after selective logging, elk will continue to use the area and be susceptible to being pushed out of any stand in one or two passes by the hunter. The primary difference is that a hunter is somewhat more likely to get a shot within the stand after it is opened up. Elk, once leaving a stand in either case, are very susceptible to mortality. Seedtree-like logging will not leave cover for elk in a portion of Unit 3, Units 8 and/or 9. In general, bull elk vulnerability will increase somewhat as a result of the Action Alternatives. The exact change can't be quantified, but is expected to be slight to moderate due to the limited circumstances under which vulnerability is increased (better chance of a shot in selectively logged areas that are a small portion of the total land area, and the loss of cover in part of Unit 3 under all Action Alternatives and in Units 8 and/or 9 under Alternatives A, B and C).

Under both the No Action and Action Alternatives, continued leasing of access across private land by sportsmen would probably allow this part of the Blacktail Mountains to become more popular as the access route becomes better known and sportsmen seek alternatives to escape the growing population of elk hunters in other parts of Southwest Montana.

2) Gravelly EMU Hunting Objectives

Discussion of the influences on other hunting objectives for the Gravelly EMU from the various alternatives are discussed below:

--*Total population goal of 8,000-8,500*: Barring any influences from changes in hunting regulations, severe winters, or the ongoing increase in access to the area, the No Action and all Action Alternatives are likely to result in continued herd growth in an area where the population is already above target.

-- *Late-winter calf:cow ratio goal of at least 45:100*. The ratio is likely to persist at slightly less than the goal under No Action or Action Alternatives. The project does not impact concentrated areas of calving and there would be little loss of habitat effectiveness to influence nutrition. A decrease in reproductive rate is often correlated with an increase in population size as shown by Gogan and Barrett (1987), Houston (1982), Eberhardt et al. (1988), McCorquodale et al. (1988), Lipscomb (1973), Clutton-Brock et al. (1987), Buechner and Swanson (1955), and data from Northeast Oregon.

-- *Harvest goal of 700-900 antlered and 800-1100 antlerless elk: Barring* any influences from changes in hunting regulations, severe winters, or the ongoing increase in access to the area, the No Action and all Action Alternatives are likely to result in continued herd growth and a correlated, but slightly to moderately increased harvest rate, resulting from increased elk vulnerability.

--*Hunting recreation goal of 34,700 days annually for a minimum of 3,600 hunters*: The No Action and all Action Alternatives would not likely influence hunter numbers directly. Recent increases in access may shift more hunters to the analysis areas from other areas within the EMU as the access becomes better known. Number of recreation days is well above target and is most likely to drop if hunters can spend less days harvesting an elk or if the elk population declines. Since elk vulnerability is likely to increase slightly to moderately under the Action Alternatives with the loss of cover discussed previously, some loss in the rate of growth in recreation days can be anticipated. If it is somewhat easier for a hunter to harvest an elk, the hunter will spend less time, on the average, harvesting an elk. Alternative D has the least effect and Alternative A the greatest effect, with B and C intermediate.

--*Temporal distribution of harvest—goal of no more than 40-45% of harvested bulls are taken during the first week*:
The No Action Alternative would result in no direct changes to the bull harvest rate during the first week of the general hunting season. The Action Alternatives may result in a slight to moderate increase in harvest that week as a result of increased vulnerability that was discussed in the Bull Elk Vulnerability section, page 96. Alternative D has the least effect and Alternative A the greatest effect, with B and C intermediate. The effects are dependent on changes in bull vulnerability, which hinge most heavily on hunter access in this Project Area where small stands can't provide adequate cover even in the existing condition.

d. <u>Cumulative Impacts on Elk</u>

Human access within the Project Area and adjacent BLM and small-private lands is increasing. This project should not contribute to increased access as far as increased numbers of people, but only in the sense of a slightly higher density of open roads (increase of .04-.05 mi/mi^2). A small acreage (20ac) is planned for timber harvest on neighboring small-private ownership. This may slightly reduce the acreage available for cover, assuming this acreage provides cover now and would be logged heavily enough to lose cover value. Past harvest on ownerships in the project area has only totaled about 4% of the forest. Cumulative effects risks appear to be low to elk habitat, hiding cover, bull elk vulnerability, and hunting objectives in the immediate area. In HD 325, the state ownership is 79,490ac, of which 3,980ac are forested. Only 45ac (1%) has been harvested in the past 50 years, with an additional 227ac planned for harvest in the West/Middle Fork Blacktail Timber Sale (for a total harvest of 6.8% of the State forest land within HD325). The selection of any of the

action alternatives would increase the harvested area on forested state land within HD325 to approximately 15%.

The BLM and USFS have been compiling data as part of a landscape analysis of the Gravelly Ecosystem. The analysis area for the ecosystem corresponds to the Gravelly Elk Management Unit. Two of the ecological landscape units (Blacktail Mountain and Sage Creek Basin) by which data is summarized fall within and contain an estimated 90% of the forest land in Hunting District 325. Analysis of LANDSAT satellite imagery (1996) indicates that timber harvest on all ownerships in the last 50 years has affected less than 1% of the forested land in Sage Creek Basin ELU and 4.2% of the Blacktail Mountains ELU. (J. Casey; Pers. Communication Feb. 1999). When considering the timber harvest since 1996 (40 acres of private land and 227 acres of the Blacktail Timber Sale to be harvested in the near future), the total cumulative timber harvest within the Blacktail Mountains ELU is estimated to be approximately 5.4% of the forested land.

Analysis of LANDSAT imagery (1996) for the entire Gravelly Elk Management Unit (Gravelly Ecosystem) indicates an estimated 3.8% (15,186 acres) of the forested 389,982 acres has been harvested in the 50 years prior to 1996. Since 1996, approximately 5,687 acres has been harvested on all ownerships. An additional timber sale (Browns Gulch) within the Elk Management Unit has been proposed by DNRC. The sale proposal is just being developed and there is insufficient information at this time to evaluate impacts. However, the proposal could harvest as much as 200 acres of timber and could be sold as early as the year 2000. Consequently, the cumulative harvest during the past 50 years is estimated to be 5.3% of the forested land. The selection of any of the action alternatives would increase the harvested area to 5.4%. Therefore, timber harvest activity has not had a substantial impact on the available security cover for elk in the Gravely Elk Management Unit.

VI RECREATION

All action alternatives would physically close all newly constructed roads. Existing roads on the State land that have been designated as open for recreational use will remain open. State lands off the designated roads would continue to be available for non-motorized recreational use.

Improvements of stream crossings on the existing roads that are producing sediment into the drainages may in the long run benefit fisheries but fishing use in the project area is not substantial.

VII GRAZING

None of the alternatives are expected to have a substantial effect on the grazing value or grazing lease arrangements within the project area. Timber harvest, through the removal of the timber canopy can result in a short-term increase in forage production. Generally, vegetation response is at its peak 3-5 years after timber harvest. Increased forage production would continue until the regenerated tree stand reaches a height where the canopy begins to close (usually 10-15 years).

Forage response is dependent on site productivity, forage value of the species present, the percent tree canopy removed and the configuration of the tree harvest. Range sites in the project area average approximately 3.8 acres per AUM. Forested acres if cleared of all trees would at most result in an allocation of approximately 5 acres per AUM. Most units in the action alternatives would not result in enough canopy removal to appreciably increase understory forage on sites accessible to cattle. The only exception would be unit #8 in alternative A, B, and C, which would result in increased forage on approximately 58 acres. A 70% canopy reduction as prescribed would result in a maximum potential increase of 8 AUM's for a 10 year lease period (58 acres*70%/5 acres per AUM), an increase in authorized livestock use of less than 0.01% on the state ownership. However the actual increase is expected to be less. Grazing leases are scheduled for evaluation prior to renewal to determine the lease terms for the next 10-year period. A tract evaluated just prior to or 1-2 years after a harvest would not recognize any increased grazing value because there is no vegetative response to consider. In addition, much of the forested area is not suitable for grazing use due to terrain and productivity limitations. Consequently no change is expected in grazing lease terms over the next 10 -15 years, if a harvest alternative is selected.

VIII TRANSPORTATION

Under all action alternatives, access to the sale would be from the Sage Creek County road. The access route would use the BLM Crooked Creek Road(#1845) from the Sage Creek road to an undesignated two track road in Sec 31 T10S R08W, then along this two track road to the divide between Crooked Creek and Divide Creek. The use of the BLM Crooked Creek road would require minor blading, installation of drainage features, and relocation out of the drainage bottom of approximately 1,500 feet of road with rehabilitation of the existing road in the drainage bottom, and minor blading and installation of drainage features on the undesignated two track road. At the saddle, approximately 140 feet of road would be relocated on BLM ground and approximately 3000 feet on private land to avoid steep sustained grades of 18 to 20%, and the existing road rehabilitated. An additional 240 feet of relocation would occur on BLM ground in Sec 29 for the approach to a hardened ford of Divide Creek. The existing unimproved ford which is directly contributing sediment to Divide Creek would be rehabilitated with water bars, grass seed, fabric sediment fence etc. to prevent further sedimentation from this source.

From the saddle in the NE ¼ of Sec 29, the road would be relocated to a crossing of Long Creek in Sec 20. This would eliminate steep the need to use the existing road with steep grades, an unimproved crossing of Long Creek, and a section of road that has been washed out due to beaver dams. A shot segment of road would be relocated in Sec 20 to avoid a steep pitch, and move the road out of the SMZ where the existing road is within 15 feet of the stream. The existing road would be replaced temporarily from the SE¼ of Sec 16 through Unit # 2 to the saddle in Sec 16. This piece of road would be obliterated with slash and revegetated with grass upon completion of the sale. (See maps by alternatives in Chapter II).

Alternative A:

In addition to the road described above common to all Action Alternatives, a portion of the road leading to the north from the saddle in Sec15 T10S R08W to the saddle in Sec 10

T10S R08W would be relocated to avoid steep grades in the existing road. A new segment of road 0.8 miles in length would be constructed from the ridge in section 10 T10S R08W to access Unit 7. A temporary CMP would be installed in the crossing of the creek in Riley Canyon. Both the relocated road and the new road would be closed and revegetated upon conclusion of use. A new road segment estimated to be 0.4 miles in length is needed to provide access to a helicopter decking area on the ridge west of the two units in Cottonwood Creek.

Alternative B:

In addition to the road described in Alternative A, three additional segments of new road would be constructed to access sale units. The first segment would consist of approximately 0.7 miles in Sections 20 and 21 from the Long Creek Road to Unit 1. A temporary CMP would be installed in the draw at the edge of the unit. The second segment would be 1.1 miles to access unit 5 from the saddle in Sec 15 T10S R08W. The third new road would be constructed for a length of 1.2 miles from the ridge above Cottonwood Creek into Unit 8. Three temporary CMPs would be installed in crossings of tributaries of Cottonwood Creek on this spur road, and would be removed upon completion of the sale.

Alternative C:

The roads proposed under Alternative C would be the same as Alternative B, with the exception that the road from the saddle in Sec 15 to Riley Canyon would not be used. No new road would be constructed in Riley Canyon.

Alternative D:

The roads proposed under Alternative D would be the same as Alternative B, with the exception that the road from the saddle in Sec 15 to Cottonwood Creek would not be used. No new road would be constructed in the Cottonwood Creek Drainage.

Alternative E (No Action):

No road construction, relocation, or improvements would be made in the existing road system. Existing unimproved fords on Divide Creek and Long Creek would continue to contribute sediment to these streams. Erosion of road surfaces would continue.

New roads constructed under all harvest alternatives would be physically closed at locations effective for closure upon completion of use. Roads within harvest units would have logging slash and brush distributed within the road prism to discourage foot traffic along its right-of-way. These roads would be revegetated upon closure. However, it must be recognized that roads even when revegetated and effectively closed to use do have some long term impacts that are difficult to quantify. The existence of a road prism, even if closed, provides an avenue or conduit for use and increases the likelihood of future development. Existing road prisms can be reopened at less expense than constructing new roads. Therefore the likelihood of future use and development is

increased to some, albeit unknown degree. The road system, under the No Action alternative, would not change.

IX CULTURAL RESOURCES

Ground disturbing activities associated with a timber harvest (primarily road construction) have the potential to destroy cultural resource sites as well as expose previously unknown sites. Consequently the alternative with the most road construction (Alternative B) would have the greatest potential for cultural resource impacts. A cultural resources inventory has identified and recorded five sites within the project area. One of the chipped stone debitage sites located on BLM ownership may be impacted through road relocation under all action alternatives. However, a formal cultural resource evaluation has been conducted, and the State Historic Preservation Office (SHPO) has been consulted. SHPO concurs that this site is not significant. Alternative E will not disturb any known sites.

If Cultural Resources are found in the area, the project would be suspended, pending further analysis by appropriate resource specialists.

X. ECONOMICS

A. Trust Revenue

The economic analysis for the Long/Cotton Timber Sale estimates the revenue from timber harvesting and non-administrative costs for the alternatives considered and displays the current returns from the Central Land Office timber program and the total program. The following assumption were used to estimate the revenue and non-administrative costs for each alternative:

1. The harvested volumes for the alternatives were based on estimates from Dillon Unit personnel.

2. The stumpage price was estimated using a residual value approach. The stumpage is an estimate for the winning bid for the timber sale. The deliver log prices were subtracted from stump to mill costs, Forest Improvement fee, development costs, and an amount for profit and risk. Profit and risk is the return to timber buyer that accounts for actual time and effort, some profit for entrepreneurial sprit, and something to cover the expected losses on an occasional sale that is not profitable.

3. The estimated delivered log price of $366.9 based on the Montana Sawlog and Veneer Log Price Report Based on a survey of mills, April – June, 1998, from Bureau of Business and Economic Research, University of Montana. Logging costs were estimated from, Costs Associated with Harvest Activities for Major Harvest Systems in Montana (Keegan et al. 1995). The costs were adjusted to current dollars. The logging costs used were; tractor = $101.28 per MBF, Cable =

$ 168.80 per MBF, and Helicopter = 262.19 per MBF. The hauling cost was estimated to $60.04 per MBF based on paved haul distance of 39 miles and unpaved haul distance of 33 miles.

Percentage of Logging System by Alternative					
	Alt A	Alt B	Alt C	Alt D	Alt E
Helicopter	50	0	0	0	0
Cable	6	48	55	23	0
Tractor	44	52	45	77	0
	100	100	100	100	0

4. Development costs were estimated for each alternative by Dillon Unit personal. Development costs are, Alternative A = $24.52 per MBF, Alternative B = $37.33 per MBF, Alternative C = $42.41 and Alternative D = $ 41.78. Development costs on this proposal are the estimated costs of road and watershed improvement items that would be paid for by the purchaser. These improvements provide access to the State Trust Lands involved and improve water quality on State Land.

5. Forest Improvement (FI) cost is based on the cost to maintain the ongoing staffing, stand and road maintenance treatments needs for the current year, right-away acquisition and program wide costs. Funds collected under FI from a purchaser provide the State funding to accomplish projects such as tree planting; site preparation; slash treatment; thinning; road maintenance; road acquisition; and for some timber sale related activities. Thus, the State is able to improve the long-term productivity of timber stands on State land and maintain or acquire access for future revenue-producing projects.

6. Sale Specific Forest Improvement costs (SSFI) are the current cost estimates for the amount and types of treatments (site preparation, hazard reduction, planting, etc) that would be done related to each of the alternatives being considered. Funding to complete these projects would be collected from future or current timber sales depending on the timing of the treatments.

7. The estimated Total $ return to the Trust is the stumpage value (bid price $/MBF) multiplied by the estimated harvest volume.

8. The estimated total dollar amount collected by the State (Total Revenue) equal Forest Improvement costs plus the stumpage value multiplied by the estimated harvest volume.

9. The cost related to the administration of the timber sale program is only tracked at the Land Office and Statewide level. We don't keep track of costs for individual timber sales.

10. Limitations of the economic analysis: (1) only known costs and benefits that are related to timber harvesting activities are considered; (2) none of the potential

benefits associated with leaving trees (i.e. snag recruitment, structural diversity, aesthetics, wildlife habitat, nutrient recycling, etc.) are considered.

11. **NO ACTION ALTERNATIVE E**--Within the project area, grazing is our only current revenue producing activity. The current grazing lease for the entire project area is 3,035 AUM's. The five year average grazing fee collected from within the project area = $13,327. The five year average grazing dollars per acre for the project is $1.14 per acre per year ($13,327/11,671). We assumed no increase in grazing AUM's from timber harvest activity.

12. Costs, revenues, and estimates of return are estimates intended for relative comparison of alternatives. They are not intended to be used as absolute estimates of return.

13. DNRC has a sustained-yield volume level of 42,164 MMBF per year Statewide. If timber is not sold and harvested relating to the highest volume alternative in this project, timber would be sold and harvested somewhere else.

TABLE IV-8: ESTIMATED STUMPAGE VALUE AND ASSUMPTIONS FOR LONG COTTONWOOD PROJECT BY ALTERNATIVE.

Value Assumption ($ per MBF)	Alt A	Alt B	Alt C	Alt D	Alt E
Delivered Log Prices (assumption 3)	$366.9	$366.9	$366.9	$366.9	$0.00
Logging Cost (assumption 3)	($186)	($134)	($138)	($117)	$0.00
Haul Cost (assumption 3)	($60.04)	($60.04)	($60.04)	($60.04)	$0.00
Development Costs (assumption 4)	($24.52)	($37.33)	($42.41)	($41.78)	$0.00
Forest Improvement Fee (assumption 5)	($8.06)	($8.06)	($8.06)	($8.06)	$0.00
Profit and Risk (assumption 2)	($36.91)	($29.10)	($29.71)	($26.56)	$0.00
Estimated Stumpage Value	$51	$98	$89	$113	$0.00

TABLE IV-9: **COSTS AND BENEFITS ASSOCIATED WITH THIS PROJECT BY ALTERNATIVE.**

	ALTERNATIVE				
	A	B	C	D	E
1. Estimated Total Harvest Volume (MBF) (Assumption 3)	2,300	2,100	1,700	1,400	0
2. Development Costs & Other costs ($/MBF) (Assumption 5 &10)	$24.52	$37.33	$42.41	$41.78	$0.00
3. Estimated Stumpage Value ($/MBF) (Table 4-6, last line)	$51	$98	$89	$113	$0.00
4. Forest Improvement ($/MBF) (Assumption 6)	$8.06	$8.06	$8.06	$8.06	$0.00
5. Estimated Stumpage Value, Forest Improvement and Development Cost ($/MBF) (Line 2 + line 3 + line 4)	$83.58	$143.39	$139.47	$162.84	$0.00
6. Total $ Value based on Estimated Stumpage Value, FI cost and Development Cost multiplied by the estimated harvest volume (line 5 * line 1)	$192,234	$301,119	$237,099	$227,976	$0
7. Estimated Stumpage Value and Forest Improvement (FI) ($/MBF) (line 3 + line 4)	$59.06	$106.06	$97.06	$121.06	$0
8. Total $ Revenue to the State (Estimated Stumpage Value + FI cost multiplied by the estimated harvest volume) (line 7 * line 1)	$135,838	$222,726	$165,002	$169,484	$0.00
9. Total $ Return to the Trust (line 1 * line 3)	$117,300	$205,800	$151,300	$158,200	$0

10. Sale Specific Forest Improvement Costs ($/MBF) (line 11 / line 1)	$1.65	$2.00	$2.23	$2.00	$0.00
11. Total $ Sale Specific Forest Improvement Costs	$3,795	$4,200	$3,791	$2,800	$0
12. Five Year Average Gross Annual Revenue From Grazing in Project Area (Assumption 11)	$13,327	$13,327	$13,327	$13,327	$13,327
13. Five Year Average Annual Revenue per Acre From Grazing in Project Area (Assumption 11)	$1.14	$1.14	$1.14	$1.14	$1.14

B Impacts on Local Communities

The impacts on local communities are estimated by quantifying jobs and income associated with harvesting and processing the timber into final products. Chuck Keegan III and Dan Wichman estimated the following regional response coefficients for the Southwestern part of Montana. The direct jobs per MMBF harvested are 12.36 per MMBF and total income per MMBF of harvested volume is $ 337,146 (Letter from Dan Wichman) or an average income of $ 33,981 per job.

It is important to note that the response coefficients are an accounting of what has happened historically. These response coefficients are average values and are not marginal values. To say the consequence of not selling this sale would result in the loss of XX amount of jobs and YYY amount of income may not be appropriate. A marginal analysis would have to be done in-order to be more certain that there will be a reduction in income and employment. If a marginal analysis is not done and the average numbers are used, this commonly results in the total impacts to be over-estimated (Godfrey and Beutler 1993).

XI. IRREVERSIBLE OR IRRETRIEVABLE COMMITMENT OF RESOURCES

Forests are a renewable resource and consequently timber harvest does not represent an irreversible or irretrievable commitment of resources. Harvest units under all alternatives would be harvested in a manner that resembles stand structures that would historically exist. The roads that are constructed however under each alternative could be considered an irretrievable commitment of resources. The roads would be closed and some partially recontoured but the road prisms would essentially be intact and easily reopened. Alternative A proposes the least amount of new road, estimated to be approximately 4.8 acres. Alternative D proposes an estimated 9.2 acres of road disturbance, Alternative C 9.9 acres. and Alternative B 13.3 acres.

XII. RELATIONSHIP BETWEEN SHORT-TERM USE AND LONG TERM PRODUCTIVITY

All harvest alternatives are designed to protect the long term productivity of the sites. It is anticipated that the stocking reduction that would occur under each alternative would increase the health and growth of residual stands resulting in an increase in long term productivity. The post harvest stands would more closely resemble stands that existed historically and would provide a variety of opportunities for use in the long term.

LITERATURE CITED

Alexander, Robert R. 1987. Ecology, silviculture, and management of the Engelmann spruce - subalpine fir type in the central and southern Rocky Mountains. Agric. Handb. No. 659. Washington DC: U.S. Department of Agriculture Forest Service. 144p

Aney, W.C. 1984. The effects of patch size on bird communities of remnant old growth pine stands in western Montana. M.S. Thesis, University of Montana, Missoula. 93pp.

Anthony, R.G., G.A. Green, E.D. Forsman, and S. K. Nelson. 1996. Avian abundance in riparian zones of three forest types in the Cascade Mountains, Oregon. Wilson Bulletin Vol. 108(2):280-291.

Basile, J. V. and T. N. Lonner. 1979. Vehicle restrictions influence elk and hunter distribution in Montana. J. Forestry 77:155-159.

Beechie, T.J., and Sibley, T.H. 1997. Relationships between Channel Characteristics, Woody Debris, and Fish Habitat in Northwestern Washington Streams. Transactions of the American Fisheries Society 126: 217-229.

Bilby, R.E., and J.W. Ward, 1991. Large woody debris characteristics and function in streams draining old growth, clear-cut, and second-growth forests in southwest Washington. Canadian Journal of Fisheries and Aquatic Sciences 48:2499-2508.

Bisson, Peter A. et al. 1987. Large woody debris in forested streams in the pacific northwest: past, present, and future. University of Washington, Institute of Forest Resources, Seattle WA. Contributions No. 57.

Blanchard, B. 1978. Grizzly bear distribution in relation to habitat areas and recreational use: Cabin Creek-Hilgard Mountains. M.S. thesis, Montana State Univ., Bozeman, MT. 75 pp.

Buechner, H.K. and C.V. Swanson. 1955. Increased natality resulting from lowered population density among elk in southeastern Washington. Proc. of the N. Am. Wildlife Conf. 20:560-567.

Bull, E.L. 1987. Ecology of the pileated woodpecker in northeastern Oregon. Journal of Wildlife Management 51(2):472-481.

Burgess, R.L., and D.M. Sharpe (eds.). 1981. Forest Island dynamics in man-dominated landscapes. Springer-Verlag, New York.

Carlson, C. E., David G. Fellin and Wyman C. Schmidt. 1983. The Western Spruce Budworm in Northern Rocky Mountain Forests. Montana Forest and Conservation Experiment Station, University of Montana, Missoula.

Christensen, A. G., L. J. Lyon, and J.W. Unsworth. 1993. Elk Management in the Northern Region: Considerations in Forest Plan Updates or Revisions. U.S.D.A. Forest Service Intermountain Research Station. General Technical Report(INT-303):

Clutton-Brock, T.H., M. Major, S.D. Albon, and F.E. Guinness. 1987. Early development and population dynamics in red deer. I. Density-dependent effects on juvenile survival. J. of Animal Ecol. 56:53-67.

Cordon, A.J., and D.W.Kelly. 1961. The influences of inorganic sediment on the aquatic life of streams. California Fish and Game 47(2):189-228.

Culver, D.R. 1993. Sensitive plant species inventory in the Centennial Valley, Beaverhead County, Montana. Unpublished Report for the Butte District, Bureau of Land Management. Montana Natural Heritage Program, Helena. 42 pp. plus appendices.

Eberhardt, L.E., L.I. Eberhardt, B.I. Tiller, and L.I. Cadwell. 1996. Growth of an isolated elk population. J. Wildlife Manage. 60(2):369-373.

Fischer, W. C., and B. D. Clayton. 1983. Fire Ecology of Western Montana Forest Habitat Types East of the Continental Divide. USDA Forest Service GTR INT-141. 83 pp.

Fritts, S. H., and L. N. Carbyn. 1995. Population viability, nature reserves, and the outlook for gray wolf conservation in North America. Restoration Ecology 3: 26-38.

Fuller, T. K. 1989. Population dynamics of wolves in north central Minnesota. Wildlife Monographs 105:1-41.

Gogan, P.J. and Barrett, R.H. 1987. Comparative dynamics of introduced tule elk populations. J. Wildlife Manage. 51(1):20-27.

Godfrey, Bruce, E. and Martin K. Beutler. June, 1993. Economic Multipliers: A Comment, Rangeland 15(3).

Graham, R. T., A. E. Harvey, M. F. Jurgensen, T. B. Jain, J. R. Tonn, and D. S. Page-Dumroese. 1994. Managing coarse woody debris in forests of the Rocky Mountains. U.S.D. A. Forest Service Research Paper INT-RP-477. 13 pp.

Green, P., J. Joy, D. Sirucek, W. Hann, A. Zack, and B. Naumann. 1992. Old growth forest types of the Northern Region. USDA Forest Service R-1 SES 4/92. Missoula, MT.

Grette, G.B. 1985. The role of large organic debris in juvenile salmonid rearing habitat in small streams. Master's thesis. University of Washington, Seattle.

Gruell, G.E. 1983. Fire and vegetative trends in the Northern Rockies: Interpretations from 1871-1982 Photographs. U.S.D.A. Intermountain Forest and Range Experiment Station. General Technical Report INT-148. Ogden, Utah. 117 pp.

Haila, Y. 1986. North European land birds in forest fragments: evidence for area effects? *In* J. Verner, M.L. Morrison, and C.J. Ralph (eds.). Wildlife 2000: modeling habitat relationships of terrestrial vertebrates. University of Wisconsin Press, Madison.

Hamlin, K. L, and M. S. Ross. 1991. Varying definitions of the legal bull: The effects on hunters, hunting, and elk populations. pp. 247-254 *in* Christensen, A. G., L. J. Lyon, and T. N. Lonner, eds, Proc. Elk Vulnerability Symp., Montana State Univ., Bozeman. 330 pp.

Hamlin, K. L., and M. S. Ross. 1993. Gravelly-Snowcrest Mountains Elk Population Dynamics and Breeding Biology. 1993 Progress Report. Montana Dept. Fish, Wildlife and Parks, Bozeman, MT. Fed Aid. Rest. Wildl. W-100-R-2.

Hamlin, K. L., and M. S. Ross. 1994. Gravelly-Snowcrest Mountains Elk Population Dynamics and Breeding Biology. 1993 Progress Report. Montana Dept. Fish, Wildlife and Parks, Bozeman, MT. Fed. Aid. Rest. Wildl. W-100-R-2.

Hamlin, K. L., and M. S. Ross. 1995. Gravelly-Snowcrest Mountains Elk Population Dynamics and Breeding Biology. 1995 Progress Report. Montana Dept. Fish, Wildlife and Parks, Bozeman, MT. Fed. Aid. Rest. Wildl. W-100-R-2.

Hansen, K., W. Wyckoff, and J. Banfield. 1995. Shifting Forests: Historical Grazing and Forest Invasion in Southwestern Montana. Forest and Conservation History. 39(2): 66-76.

Hayward, G. D. 1994. Review of technical knowledge: boreal owls. Pages 92-127 *in* G.D. Hayward and J. Verner (tech. eds). Flamulated, boreal, and Great grey owls in the United States: a technical conservation assessment. USDA Forest Service GTR-RM-253. 214 pp

Heede, B.H., 1975. Mountain watersheds and dynamic equilibrium. In Watershed Management Symposium. American Society of Civil Engineers, Logan Utah. p.407-419.

Heidel, B.L. 1996. Montana plant species of special concern. [Unpublished list.] Montana Natural Heritage Program, Helena. 31 pp.

Heidel, B.L. 1997. Montana plant species of special concern. [Unpublished list.] Montana Natural Heritage Program, Helena. 34 pp.

Hibbert, A.R. 1967. Forest treatment effects on water yield. Int. Symp. On Forest Hydrology Proc., P. 527-543. Penn State University. Pergamon Press, N.Y.

Hillis, J. M., M. J. Thompson, J. E. Canfield, L. J. Lyon, C. L. Marcum, P. M. Dolan, and D. W. McCleerey. 1991. Defining elk security: the Hillis paradigm. pp. 38-43 *in* Christensen, A. G., L. J. Lyon, and T. N. Lonner, eds, Proc. Elk Vulnerability Symp., Montana State Univ., Bozeman. 330 pp.

Hitchcock, C.L. and A. Cronquist. 1955. Vascular Plants Of the Pacific Northwest; Vol. 5: Compositae. University of Washington Press, Seattle WA. 343 pp.

Jensen, W. F., T. K. Fuller, and W. L. Robinson. 1986. Wolf (*Canis lupus*) distribution on the Ontario-Michigan border near Sault Ste. Marie. Can Field-Nat. 100: 363-366.

Keegan III, Charles E., Fiedler, Carl E. and Wichman, Daniel. 1995. Costs Associated with Harvest Activities for Major Harvest Systems in Montana. Forest Product J. 45(7/8):78-82.

Keegan III, Charles E. And Daniel Wichman. 1996, Bureau of Business and Economic Research, University of Montana, Missoula, Mt. Letter on Income and Employment to Will Wood, DNRC.

Kie, J. G., J. A. Baldwin, and C. J. Evans. 1994. CALHOME Home range analysis program. USDA Forest Service Pacific Southwest Research Station.

Knight, R.R. 1970. The Sun River elk herd. Wildl. Monogr. No. 23. The Wildlife Society, Washington, D.C. 66pp.

Langer, O.E. 1980. Effects of sedimentation on salmonid stream life. Environment Canada. Environmental Protection Service, unpublished report. North Vancouver, B.C.

Lehmkuhl, J.F., and L.F. Ruggiero. 1989. Forest Fragmentation in the Pacific Northwest and its potential effects on wildlife. *In* L.F. Ruggiero, K.B. Aubry, A.B. Carey, and M. H. Huff (tech. coords.). Wildlife and vegetation of unmanaged Douglas-fir forests. U.S. Forest Service Gen. Tech. Rep. PNW-GTR-285. Portland, OR.

Lehmkuhl, J.F., L.F. Ruggiero, and P.A. Hall. 1989. Landscape-level patterns of wildlife abundance in the southern Washington Cascades. *In* L.F. Ruggiero, K.B. Aubry, A.B. Carey, and M. H. Huff (tech. coords.). Wildlife and vegetation of unmanaged Douglas-fir forests. U.S. Forest Service Gen. Tech. Rep. PNW-GTR-285. Portland, OR.

Lipscomb, J.F. 1973. Systems modeling big game populations. Pages 263-273 *in* Game Research Report, Part 3. Prog. Rep. P-R Proj. W-38-R-27, Work Plan 17, Job 1. Colorado Div. of Wildlife, Denver.

Losensky, B. J. 1993. Historical vegetation in Region One by climatic section. USDA Forest Service, Northern Region, draft report, revision three.

Losensky, B.J. 1997. Historical Vegetation of Montana. Mt. DNRC. Missoula Mt. Report prepared under contract. 100 pp.

Lyon, L.J., and J.E. Canfield. 1991. Habitat selection by Rocky Mountain elk under hunting season stress. pp. 99-105 *in* A.G. Christensen, L.J. Lyon, and T.N. Lonner, comps., Proc. Elk Vulnerability Symp., Montana State Univ., Bozeman. 330 pp.

MacDonald, L.H. 1991. Monitoring guidelines to evaluate effects of forestry activities on streams in the Pacific Northwest and Alaska. U.S. Environmental Protection Agency. 166 p.

Mace, R. D., and T.L. Manley, T. L. 1993. South Fork Flathead River Grizzly Bear Project: Progress Report for 1992. Montana Department of Fish, Wildlife and Parks.

Marcot, B. G., M. J. Widsom, H. W. Li, and G. C. Castillo. 1994. Managing for featured, threatened, endangered, and sensitive species and unique habitats for ecosystem sustainability. USDA Forest Service GTR PNW-329. 39 pp.

Marcum, C.L. 1975. Summer-fall habitat selection and use by a western Montana elk herd. Ph.D. Thesis., University of Montana, Missoula. 188pp.

Mattson, D. J., B. M. Blanchard, and R. R. Knight. 1991. Food habits of Yellowstone grizzly bears, 1977-1987. Can. J. Zool. 69: 1619-1629.

MBEWG (Montana Bald Eagle Working Group). 1994. Montana Bald Eagle Management Plan. USDI, Bureau of Land Management, Billings, MT. 61 pp.

McCorquodale, S.M., L.L. Eberhardt, and L.E. Eberhardt. 1988. Dynamics of a colonizing elk population. Journal of Wildlife Management 52(2):309-313.

Mech, L. D. 1995. The challenge and opportunity of recovering wolf populations. Conservation Biology 9: 270-278.

Mech, L. D. 1989. Wolf population survival in an area of high road density. Am. Midl. Nat. 121: 387-389.

Mech, L. D., S. H. Fritts, G. Radde, and W. J. Paul. 1988. Wolf distribution and road density in Minnesota. Wildl. Soc. Bull. 16: 85-87.

Megahan, W.F., 1976. Effects of forest cultural treatments upon streamflow. In: The Forest Acts Dilemma Symposium, 1975. Proceeds Montana Forest and Conservation Experiment Station, University of Montana. pp.14-34.

Mladenoff, D. J., T. A. Sickley, R. G. Haight, and A. P. Wydeven. 1995. A regional landscape analysis and prediction of favorable gray wolf habitat in the northern Great Lakes region. Conservation Biology 9: 279-294.

Montana Bird Distribution Committee. 1996. P.D. Skaar's Montana bird distribution. Fifth edition. Special Publication No. 3. Montana Natural Heritage Program, Helena. 130pp.

Montana Department of Fish, Wildlife and Parks. 1992. Statewide Elk Management Plan.

Montana Department of Fish, Wildlife and Parks. 1995. Elk population dynamics & breeding biology—Gravelly-Snowcrest Mountains 1995 progress report. Montana Dept. of Fish, Wildlife and Parks, Helena. 28pp.

Montana Department Of Fish, Wildlife and Parks, Hess and Oswald. 1991. Montana River Information System. unpubl. data.

Montana Department Of Natural Resources and Conservation. 1997. Proposed West/Middle Fork Blacktail Creek timber sale. Draft environmental impact statement. Montana Department of Natural Resources, Helena. 107pp.

Montana Natural Heritage Program. 1995. Results of querry, Montana Natural Heritage Program. May 1995. unpubl. data.

Murphy, M.L., and K.V. Koski, 1989. Input and depletion of woody debris in Alaska streams and implications for streamside management. North American Journal of Fisheries Management 9: 427-436.

NCASI. 1987. Review of minimum management requirements for indicator species: pine marten and pileated woodpecker. Technical Bulletin No. 522. National Council of the Paper Industry for Air and Stream Improvement, Inc., New York.

Nelson, L.J. and J.M. Peek. 1982. Effect of survival and fecundity on rate of increase of elk. J. Wildlife Manage. 46(2):535-540.

Newcombe, C.P., and D.D. MacDonald. 1991. Effects of suspended sediments on aquatic ecosystems. North American Journal of Fisheries Management 11:72-82.

Olson, G. 1981 Effects of Seismic Exploration on Summering Elk in the Two-Medicine-Badger Creek Area, Northcentral Montana. Unpublished Report, Montana Dept. of Fish< Wildlife and Parks.

Oswald, R. 1997. Personal correspondence 10-28-97. DNRC Project File.

Pecora, W.C. 1987. Geology of the Blacktail Mountains, Southwestern, Montana: Middleton , Conn., Wesleyan University, M.A. Thesis, 203p.

Pfankuch, D.J., 1978. Stream Reach Inventory and Channel Stability Evaluation. USDA, Forest Service Northern Region.

Pfister, R. D., Bl. L. Kolvalchik, S. F. Arno, and R. C. Presby. 1977. Forest habitat type of Montana. USDA FS GTR-INT-34. 174 pp.

Picton, H.D. 1960. Migration patterns of the Sun River elk herd, Montana. J. Range Manage. 24(3):279-290.

Ralph, C.J., P.W.C. Paton, and C.A. Taylor. 1991. Habitat association patterns of breeding birds and small mammals in Douglas-fir/hardwood stands in northwestern California and southwestern Oregon. USDA Forest Service GTR-PNW-285. 15pp.

Raphael, M.G. 1984. Wildlife populations in relation to stand age and area in Douglas-fir forests of northwestern California. *In* W.R. Meehan, R.R. Merrell, and T.A. Hanley (eds.). Fish and wildlife relationships in old-growth forests. Amer. Inst. Fish. Res. Biol.:259-274.

Reichel, J. D., and S.G. Beckstrom. 1994. Northern bog lemming survey: 1993. Montana Natural Heritage Program, Helena, Mt. 87 pp.

Restani, M. 1991. Resource partitioning among three *Buteo* species in the Centennial Valley, Montana. The Condor 93: 1--7-1010.

Rosenburg, K.V., and M.G. Raphael. 1986. Effects of forest fragmentation on vertebrates in Douglas-fir forests *in* J. Verner, M.L. Morrison, and C.J. Ralph (eds.). Wildlife 2000: modeling habitat relationships of terrestrial vertebrates. Univ. Wisconsin Press, Madison.

Rosgen, D.L. 1994. A classification of natural rivers. Catena 22:(1994) Elsevier Science B.V. p.169-199.

Rosgen, D.L. 1996. Applied river morphology. Wildland Hydrology, Pagosa Springs, CO.

Sallabanks, R. 1996. Avian biodiversity and bird-habitat relationships in conifer forests of the Inland Northwest: an ecosystem management approach. 1995 annual report to: Boise Cascade Corp., Nat. Fish & Wildl. Found. NCASI, and USDA Forest Service. Sustainable Ecosystems Institute, Meridian, Idaho.

Sedell, J.R., F.J. Swanson, and S.V. Gregory. 1984. Evaluating fish response to woody debris. Pages 222-245 *in* Pacific Northwest stream habitat management workshop. California Cooperative Fishery Research Unit, Humboldt State Univ. Arcata, CA.

Sedell, J.R., F.J. Swanson, and S.V.Gregory. 1988. What we know about large trees that fall into streams and rivers. P. 47-81, In: From the Forest to the Sea: A story of Fallen Trees. USDA Pacific Northwest Research Station, Gen. Tech. Report. PNW-GTR-229.

Servheen, C.W., and P. Sandstrom. 1993. Human activities and linkage zones for grizzly bears in the Swan-Clearwater Valleys, Montana. USDI Fish and Wildl. Serv., Missoula, Mont. 28 pp.

Sorenson, D.L., M.M. McCarth, E.J. Middlebrooks, and D.B. Porcella. 1977. Suspended and dissolved solids effects on biota: A review. EPA-600/3-77-042. US EPA, Environmental Research Laboratory, Corvallis, Oregon. 64p.

Stowell, R. A. Espinosa, T.C.Bjornn, W.S.Platts, D.C. Burns, and J.S. Irving. 1983. Guide for predicting salmonid response to sediment yields in Idaho batholith watersheds. USDA Forest Service, Northern Region, Missoula, MT. Technical Circular.

Thiel, R. P. 1985. The relationship between road densities and wolf habitat suitability in Wisconsin. Am. Midl. Nat. 113: 404-407.

Thomas, J.W. (ed.). 1979. Wildlife habitats in managed forests: the Blue Mountains of Oregon and Washington. U.S.D.A. Forest Service, Agriculture Handbook No. 553. 512pp.

Thomas, J. W. 1991. Elk vulnerability - A conference perspective. pp. 318-319 in Christensen, A. G., L. J. Lyon, and T. N. Lonner, eds, Proc. Elk Vulnerability Symp., Montana State Univ., Bozeman. 330 pp.

Thompson, L. S. 1982. Distribution of Montana amphibians, reptiles, and mammals. Montana Audubon Council, Helena. MT.

Thurber, J. M., R. O. Peterson, T. D. Drummer, and S. A. Thomasma. 1994. Gray wolf response to refuge boundaries and roads in Alaska. Wildlife Society Bulletin 22: 61-68.

Troendle, C.A., 1987. The potential effects of partial cutting and thinning on streamflow from the subalpine forest. USDA Forest Service Research Paper RM-274, Rocky Mnt. Forest and Range Experiment Station, Fort Collins, Colorado, 7pp.

USDA Forest Service, Region 1. 1974. Forest hydrology, hydrologic effects of vegetation manipulation, Part II. Missoula, MT.

USDI. 1985. U.S. Fish and Wildlife's biological opinion on the Beaverhead National Forest proposed Forest Plan. unpubl. report.

USFS 1992. Biological Evaluation of Threatened, Endangered, and Sensitive Species for the West Fork Madison Timber Harvest. Beaverhead National Forest, Dillon, MT.

USFS 1995. Biological Evaluation of Threatened, Endangered, and Sensitive Species for the Rescue Salvage Sale. Beaverhead National Forest. May 3, 1995. unpubl. report.
USFWS. 1986. Recovery Plan for the Pacific Bald Eagle. USFWS, Portland, OR. 160 pp.

USFWS. 1987. Northern Rocky Mountain Wolf Recovery Plan. U.S. Fish and Wildlife Service. 119 pp.

USFWS 1993. Grizzly Bear Recovery Plan (Revision). U.S. Fish and Wildlife Service. 181 pp.

Vanderhorst, J. and Peter Lesica. 1994. Sensitive plant survey in the Tendoy Mountains, Beaverhead County, Montana. Unpublished report to the Bureau of Land Management. Montana Natural Heritage Program, Helena. iv + 59 pp. plus appendices.

Weaver, J. 1979. Wolf predation upon elk in the Rocky Mountain parks of North America: a review. *In* M.S. Boyce and L.D. Wing (eds.). North American elk: ecology, behavior, and management. University of Wyoming, Laramie. 294pp.

Whitcomb, R.F., C.S. Robbins, B.L.Whitcomb, M.K. Klimkiewicz, and D. Bystrak. 1981. Effects of forest fragmentation on avifauna of the eastern deciduous forest. *In* R.L. Burgess, and D.M. Sharpe (eds.). 1981. Forest Island dynamics in man-dominated landscapes. Springer-Verlag, New York.

Worton, B. J. 1989. Kernel methods for estimating the utilization distribution in home-range studies. Ecology 70: 164-168.

LIST OF PREPARERS

Stan Vlahovich	Dillon Unit Manager
Ken Bullman	Forester, Dillon Unit
Rich Harris	Wildlife Biologist, DNRC Missoula
Brian Pilcher	Wildlife Biologist, Independent Consultant, Dillon
John Muhlfeld	Hydrologist, DNRC Missoula
Jeff Collins	Soils Scientist, DNRC Missoula
Patrick Rennie	Archaeologist, DNRC Helena
Will Wood	Economist, DNRC Missoula
Donna Leeper	GIS Specialist, DNRC Missoula
Ross Campbell	Graphic Design, DNRC Helena
Garry Williams	Forest and Lands Manager, DNRC Helena
Terry Lane	Environmental Specialist, DNRC Missoula
Tom Schultz	Environmental Specialist, DNRC Missoula
Gary Frank	Hydrologist, DNRC Missoula

LIST OF INDIVIDUALS OR ORGANIZATIONS CONSULTED

Dick Oswald, Mt. Dept of Fish, Wildlife and Parks, Dillon
Bob Brannon, Mt. Dept of Fish, Wildlife and Parks, Dillon
Ken Hamlin, Mt. Dept of Fish, Wildlife and Parks, Bozeman
Bureau of Land Management, Dillon Resource Area, Dillon
USFS, Beaverhead National Forest, Dillon Ranger District, Dillon
Katharine Jurist, Montana Natural Heritage Program, Helena
Jim Till. U.S. Fish and Wildlife Service, Kalispell
Ron Wiseman, U.S. Forest Service, Ennis
Gary Olsen, Mt Dept of Fish, Wildlife and Parks, Conrad

Persons with disabilities who need an alternative, accessible format of this document should contact DNRC at 1625 Eleventh Avenue, P.O. Box 201601, Helena, MT 59620-1601.

40 copies of this public document were published at an estimated cost of $14.25 per copy. The total cost of $570.00 includes $550.00 for printing and $20.00 for distribution.

Department of Natural Resources and Conservation
Central Land Office
8001 North Montana Avenue
Helena, Montana 59602

E-mail: gary@mt.net